
# Informe Productividad 2016
# DIE-UC

# TABLA DE CONTENIDO

# INTRODUCCION

Durante el año 2016, el Departamento de Ingeniería Eléctrica de la Pontificia Universidad Católica de Chile, ha continuado con su labor de investigación a través de estudios publicados en revistas, tesis y el desarrollo de proyectos financiados por Fondecyt, Fondef y otras fuentes en las diferentes especialidades de la Ingeniería Eléctrica.

El presente Informe reúne lo publicado por los profesores e investigadores de nuestro Departamento en sus distintas especialidades y tiene por objetivo dar a conocer en forma más detallada el trabajo de investigación realizado durante el año 2016.

El Informe incluye los siguientes contenidos:

- Tesistas graduados del Programa de Doctorado en Ciencias de la Ingeniería.
- Tesistas graduados del Programa de Magister en Ciencias de la Ingeniería.
- Memoristas titulados de Ingeniero Civil
- Publicaciones en revistas ISI.
- Publicaciones en Congresos.
- Otras publicaciones
- Capítulos de libros
- Proyectos de investigación desarrollados.

## INDICES DE PRODUCTIVIDAD AÑO 2016

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|---|---|
| **Titulados Ing. Civil Electricista** | **24** |
| **Titulados Ing. Civil Industrial Eléctrico** | **37** |
| **PhD. Ciencias de la Ingeniería** | **5** |
| **Magíster en Ingeniería** | **1** |
| **Magister en Ciencias de Ingeniería** | **14/12** |
| **Memoristas Ingeniería Civil** | **5** |
| **Doble Título con Grade École, Francia** | **1** |
| **Doble Título con politécnicos, Italia** | **1** |
| **Publicaciones ISI** | **45** |
| **Publicaciones en Congresos** | **26** |
| **Otras Publicaciones** | **2** |
| **Capítulos de Libros** | **1** |
| **Proyectos de Investigación** | **46** |
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# I. TESISTAS GRADUADOS DEL PROGRAMA DE DOCTORADO EN CIENCIAS DE LA INGENIERIA

**Tesista: Aguirre Reyes, Daniel Fernando.**
**Tesis: "Steatosis hepatic quantification using magnetic resonance imaging".**
Supervisor: Pablo Irarrázaval
Fecha de la defensa: 18-01-2016
Resumen:
El principal método de diagnóstico de la esteatosis hepática es la biopsia, procedimiento invasivo y riesgoso con problemas de muestreo. Por esta razón, es necesario un método de cuantificación no invasivo y global. No toda la grasa acumulada en los tejidos tiene las mismas características físicas ni biológicas. Por lo tanto no solo es necesario avanzar en una mejor cuantificación de la grasa total, sino también en su caracterización no-invasiva. Existen métodos de cuantificación de grasa con imágenes de resonancia magnética, pero en general obtienen resultados imprecisos. En este trabajo se proponen algunas formas de medir la cantidad de grasa en el hígado utilizando métodos indirectos, como la hipertensión portal intrahepática, y la espectroscopía para caracterizar la presencia de ácidos grasos en un elemento volumétrico. El objetivo es caracterizar la grasa por medio de sus metabolitos, y usando un algoritmo de optimización, estimar qué tipo de ácidos grasos la conforman, con el fin de modelar el estado de la grasa y clasificarlo como normal, esteatosis hepática o esteatohepatitis.
En etapas posteriores se podrá aplicar el método de caracterización de ácidos grasos propuesto, en imágenes tridimensionales, con el objetivo de conocer la distribución de grasa en todos los lóbulos del hígado.

**Tesista: Basaure Quintana, Arturo Fernando.**
**Tesis: "Regulation for dynamic spectrum management".**
Supervisor: Vladimir Marianov
Fecha de la defensa: 02-09-2016
Resumen:
La administración del espectro radioeléctrico está en el corazón del acceso a Internetmóvil e inalámbrico y es por eso de vital importancia para asegurar los procesos más importantes de nuestra sociedad moderna. El incremento en la demanda por nuevos servicios urge a las autoridades de regulación nacional (NRAs) a promover un uso más eficiente del espectro. En este contexto, las tecnologías de acceso dinámico del espectro (DSA) y su relacionado manejo dinámico (DSM) pueden proveer nuevos medios para administrar este recurso, asignando dinámicamente al espectro que no está siendo eficientemente utilizado (espacios blancos).Esta tesis combina el modelamiento basado en el agente con la dinámica de sistemas para estudiar la administración del espectro desde el punto de vista de la economía neo-institucional dinámica. Es decir, este trabajo combina las teorías económicas de costos de transacción con la evolutiva para analizar al ecosistema de las TICs, que padece de constantes cambios.Esta tesis consta de seis publicaciones donde se analizan las ganancias en eficiencia causadas por la introducción de las tecnologías DSA y los cambios requeridos a la regulación.

**Tesista: Bronfman Cáceres, Andrés.**
**Tesis: "Hazardous materials transportation in urban areas".**
Supervisor: Vladimir Marianov
Fecha de la defensa: 12-10-2016
Abstract:
This thesis aims to model and solve the HAZMAT (Hazardous Material) Transportation Problem in urban zones. We develop three new techniques to solve the problem, stressing out population protection in case of HAZMAT release events during transport. The first technique focuses on the protection of population groups that are vulnerable or hard to evacuate, through the maximization of the distance between the closest vulnerable center and the designed route. We name it the maximim HAZMAT routing problem. The second technique maximizes the sum of the distances between every vulnerable center and its closest route, and it is denoted the maxisum HAZMAT routing problem. In these approaches, the distance is used as an estimator of the danger to which the vulnerable centers are exposed. In other words, the lesser the distance, the higher the danger. The third technique explicitly considers a general danger estimator for every populated center, incorporating also the population exposure time as another proxy. The resulting models were tested in a real case study of HAZMAT transport in Santiago de Chile.

**Tesista: Paredes Belmar, Germán Enrique.**
**Tesis: "Vehicle routing problems with product mixing and extensions".**
Supervisor: Vladimir Marianov
Fecha de la defensa: 11-10-2016
Resumen:
El problema de ruteo de vehículos con mezcla de productos consiste en transportar bienes de distinto tipo/calidad ofrecidos o demandados por un conjunto de clientes, utilizando una flota de vehículos. El problema estudiado en esta tesis, considera que la mezcla de dos o más productos, en un mismo vehículo, puede producir cambios en el estado de los productos o la carga del vehículo. Por lo tanto, se necesita realizar un seguimiento y estudio de las interacciones entre los distintos productos cargados en cada vehículo. Este enfoque no ha sido abordado en la literatura especializada. Esta tesis presenta modelos matemáticos y métodos de resolución para tres problemas que incluyen mezclas de productos en un mismo vehículo: Recolección de leche con mezclas; Recolección de leche con mezclas y puntos de recolección y Recolección de HAZMAT con múltiples cargas de productos. En ambos problemas de recolección de leche, se muestra la conveniencia de permitir mezclas de distintas calidades de leche para reducir los costos de transporte e incrementar el beneficio neto. En el problema de recolección de HAZMAT, se muestran las ventajas de combinar distintos tipos de residuos peligrosos, para reducir riesgos y costos de transporte.

**Tesista: Sotelo Parraguez, Julio Andrés.**
**Tesis: "3D quantification of cardiovascular hemodynamic parameters from 4D flow data using A finite element interpolations".**
Supervisor: Sergio Uribe
Fecha de la defensa: 17-08-2016
Abstract:
3D cine PC-MRI provides measurements of blood flow velocities in three orthogonal directions. These newdatasetsthat can potentially allow us to obtain new insight of the cardiovascular system. However, there are several issues regarding the quantification of the data that has hampered its translation to the clinic. Different techniques have been applied to obtain cardiovascular parameters from the 3D cine PC-MRI, includingwall shear stress, vorticity, helicity and pressure maps. However, most of these methods quantify these cardiovascular parameters using reformatted 2D planes, with the lack of performing real 3D quantification. In this Thesis we integrate advanced image processing strategies and algorithms based on finite element interpolations to perform 3D quantification of cardiovascular parameters using the 3D velocity field provided by 3D cine PC-MRI. Weperformeda 3D quantification of the velocity field for obtaining continuous 3D maps of vorticity, helicity density and wall shear stress based onafinite element approach. Also,we used a MRI based CFD model to calculate pressure gradient in patientswith aortic coarctation (CoA).In conclusion, we have developed a novel methodology to calculate 3D maps of hemodynamic parameters using finite element interpolations and 3D cine PC-MRI data. The method directly incorporates both the in-plane and longitudinal velocity gradients, resulting in more accurate estimates of different hemodynamic parameters values than current methods based on 2D analysis. We close by remarking that the finite-element framework described in this work is not restricted to the quantification of vorticity, helicity density and wall shear stress, but can be adapted to the estimation of other important biomechanical parameters that depend on field gradients. Also,we have shown that a simple MRI based CFD model can accurately predict the pressure gradient in patients with CoA at rest condition.

## II. TESISTAS GRADUADOS DEL PROGRAMA DE MAGISTER EN CIENCIAS DE LA INGENIERIA

**Tesista: Aldunate Fernández, José Santiago.**
**Tesis: "Control híbrido para conversor multinivel con múltiples capacitores flotantes".**
Supervisor: Javier Pereda
Fecha de la defensa: 21-04-2016
Resumen:
Aunque los conversores multinivel puente-H en cascada (CHB) presentan beneficios como alta modularidad, posible optimización del número de niveles por asimetrías y bajo modo común, la necesidad de una fuente DC aislada y bidireccional por puente-H aumenta largamente el costo y reduce la confiabilidad del conversor. Este artículo presenta la implementación de un conversor CHB que reemplaza fuentes independientes en dos series de puentes por capacitores flotantes mediante un control híbrido, que combina un control de fundamental por índice de modulación y un control predictivo (MPC). El conversor presenta una alta calidad de potencia en todo el rango de voltaje y frecuencia, una alta eficiencia en voltajes altos y menor ruido electromagnético (EMI). Para justificar el uso y la aplicabilidad del control, el trabajo propuso un modelo matemático de la potencia de los auxiliares en función del índice de modulación, una serie de simulaciones en condiciones estáticas y dinámicas y posteriormente la implementación de estas mismas condiciones en laboratorio. Los resultados muestran la factibilidad del control híbrido para reemplazar fuentes aisladas con capacitores, en las tres fases, con una buena respuesta dinámica. Entre las posibles aplicaciones se encuentran vehículos eléctricos, sistemas de transmisión AC flexibles y generación de energía eléctrica.

**Tesista: Arias Yurisch, Rodrigo Javier.**
**Tesis: "Desarrollo y aplicación de controladores para mejorar el amortiguamiento en sistemas de potencia de gran escala".**
Supervisor: Sebastián Ríos
Fecha de la defensa: 11-08-2016
Resumen:
En esta Tesis se abordan las problemáticas de los modos de oscilación electromecánicos de baja frecuencia, en los sistemas eléctricos de potencia (SEP). Dichas oscilaciones corresponden a uno de los principales desafíos en los SEP que, por lo general, están constituidos por líneas de transmisión largas, con una clara estructura longitudinal y que operan fuertemente cargadas. Estructuras de este estilo se presentan en diversos países tales como Brasil, Estados Unidos, Ecuador y particularmente en el sistema eléctrico chileno. La Tesis analiza en detalle las oscilaciones electromecánicas desde sus causas y efectos primarios, hasta el diseño y sintonización de los dispositivos de control disponibles en la actualidad, tales como los dispositivos FACTS y los estabilizadores de sistemas de potencia (PSS). Con el objeto de entender el fenómeno en estudio, en esta Tesis se clarifican, en primer lugar, los conceptos básicos que explican la estabilidad de los sistemas de potencia, dándose un énfasis particular a la estabilidad angular y a los fenómenos de inestabilidad ante pequeñas perturbaciones.

Seguido, se presenta la clasificación e identificación de los modos de oscilación electromecánicos y su asociación con los elementos participantes mediante el análisis de los valores propios del SEP. A continuación, se identifican las máquinas sincrónicas con mayor participación en dichos modos de oscilación, definiendo el punto de partida de la metodología propuesta. La construcción de la metodología propuesta en este estudio se basa en una técnica metaheurística. Con el fin de entender la selección de la técnica metaheurística, se describen en detalle las técnicas que resultan más relevantes en la literatura. La técnica metaheurística seleccionado es el PSO (Particle Swarm Optimization), la cual es usada para la sintonización de los PSS y de los amortiguadores de las oscilaciones de potencia dispuestos tanto en los compensadores de reactivos (SVC) como en los capacitores serie controlados por tiristores (TCSC). La metodología propuesta permite identificar a las máquinas más relevantes para incorporarles un PSS, definir su señal de entrada y determinar las características de fase y ganancia de los respectivos estabilizadores. La metodología contempla la sintonización coordinada de los distintos tipos de estabilizadores existentes en el SEP. Dicha metodología es aplicada al caso chileno, un sistema de potencia de gran escala compuesto por más de 14000 terminales, más de 300 generadores y líneas de transmisión entre 66kV y 500kV. La modelación entre la interconexión de los sistemas SIC y SING se realiza a través de una línea de doble circuito de corriente alterna, de aproximadamente 578km, con una subestación intermedia. Particularmente, los resultados de este estudio se basan en la verificación del desempeño de los ajustes propuestos en el futuro sistema eléctrico chileno, tanto para pequeñas perturbaciones en modos de oscilación locales e interárea, como ante fallas en el sistema de transmisión. Adicionalmente, se presenta un análisis comparativo entre la respuesta del sistema antes y después de la incorporación de los controladores. Finalmente, en base a los resultados obtenidos se presentas las conclusiones del trabajo y se realizan recomendaciones para trabajos futuros en esta área de investigación.

**Tesista: Busch Hopfenblatt, Nicolás Axel.**
**Tesis: "A combined RRT*-optimal control approach for kinodynamic motion planning for mobile robots".**
Supervisor: Prof. Miguel Torres
Fecha de la defensa: 02-03-2016
Abstract:
An important challenge in underground mining is that of motion planning for excavators and hauling trucks because of the tight spaces available to maneuver and fuel consumption. During the last decades several path planning strategies for mobile robots have been developed. However, most of the existing methods only find a path that satisfies certain optimality criteria, but do not consider the feasibility of the path accordingly with the robot's motion dynamics. Thus in this work two motion planning strategies are proposed that combine the RRT* path planning algorithm with the piecewise solution of an optimal control problem over a finite number subintervals of a simpler polygonal trajectory derived from the path found by RRT*. The proposed approaches take into account the motion model of the robot, hence yield kinodynamically feasible trajectories. One strategy solvesa local two-point boundary value optimal control problem at the corners of the polygonal path, while the second solves the two-point boundary value optimal control problem taking consecutive points of the polygonal trajectory. Geometrically, the first approach connects straight lines with curves at the turning points of the path, and the second approach yields smooth curves. In both cases the trajectories can be tracked by the motion controller with negligible errors compared to the trajectories that

follow the RRT* path. However, an important difference between the proposed methods lies in the fact that the second one is able to yield trajectories that can be followed with an almost constant longitudinal velocity and gradual changes in heading turning rates. The proposed approaches were evaluated in simulations and tested in field experiments using a robotic excavator implemented with a Caterpillar CAT 262C2 compact loader. The results show that proposed approaches are computationally feasible on current standard computers and reduce the combined tracking error and controller effort criteria by3070 %, depending on the complexity of the path.

**Tesista: Calabi Guzmán, Daniel Alberto.**
**Tesis: "Modelo de tracción y controlador de resbalamiento para excavadoras robotizadas".**
Supervisor: Prof. Miguel Torres
Fecha de la defensa: 25-01-2016
Resumen:
La automatización y teleoperación de vehículos, particularmente cargadores y excava- dores, posee grandes ventajas tales como el mejoramiento de la seguridad de los conductores, la reducción del consumo de energía y el aumento de la productividad. Cuando el sistema opera correctamente se maximiza la capacidad de carga de cada máquina a la vez que se reducen los errores humanos de conducción y con esto el tiempo que las máquinas deben ser reparadas en el taller. Una de las dificultades que han surgido al hacer que las máquinas sean teleoperadas o autónomas es el resbalamiento de las ruedas del vehículo, puesto que al no haber un conductor físicamente presente, no hay alguien que pueda percibir a través de las vibraciones y el ruido del motor que se hace necesario dejar de acelerar para no resbalar. Por lo anterior, se produce un mayor desgaste de neumáticos y consumo de combustible en máquinas teleoperadas, particularmente en los equipos LHD (load, haul and dump) empleados para mover rocas y tierra en minería subterránea. Los modelos existentes de resbalamiento tienen problemas en describir la transición entre rodadura perfecta y resbalamiento, particularmente porque a bajas velocidades se indefine la razón entre la velocidad angular de las ruedas y la velocidad del vehículo. Por otro lado, los modelos existentes requieren parámetros de deformación rueda-terreno y el hundimiento de la rueda, ya que estas son dos características macroscópicas que permiten en gran parte explicar la resistencia a la rodadura y la tracción. Sin embargo, el proceso físico es más complejo e involucra también interacciones a nivel microscópico en el área de contacto que son difíciles de modelar. Por esta razón se propone un modelo de tracción computacionalmente simple que no requiera la modelación de fenómenos microscópicos, y a la vez que no requiera de supuestos de hundimiento o deformación de ruedas, ya que en pavimentos de tierra compactada u hormigón, los vehículos con ruedas rígidas o casi indeformables se comportan de manera muy similar a los vehículos con ruedas deformables o sobre terreno deformables, como caminos de ripio, arena, nieve o barro. El trabajo presentado modela la fuerza de tracción efectiva de un vehículo a partir del producto clásico entre el coeficiente de roce rueda-terreno y la fuerza normal sobre la rue- da, pero agrega de manera novedosa el resbalamiento sin la necesidad de incorporar los parámetros de deformación de la rueda-terreno y hundimiento. De esta manera, a partir del modelo se desarrolló un controlador que disminuye de manera efectiva el resbalamiento ajustando el torque aplicado a las ruedas. El modelo de tracción fue validado experimentalmente utilizando un cargador compacto de giro deslizante CAT262 C2 conducido en pavimento seco y ripio. El controlador de resbalamiento se evaluó en una serie de experimentos bloqueando la pala para evitar que la máquina siga

avanzando, creando de esta manera condiciones de resbalamiento puro. Se utilizó un cargador compacto robotizado para validar la factibilidad de emplear el método propuesto en aplicaciones industriales, en vez de los robots pequeños usualmente utilizados en los laboratorios de investigación.

**Tesista: Cancino Vera, Braulio Javier.**
**Tesis: "Estudio, diseño e implementación de un driver de reloj para CCD utilizando la fuente de corriente de howland mejorada".**
Supervisor: Prof. Angel Abusleme
Fecha de la defensa: 26-01-2016
Resumen:
Los detectores CCD son dispositivos ampliamente utilizados en la astronomía que cumplen la función de generar carga eléctrica medible a partir de fotones. El proceso de lectura de los CCDs implica una etapa de transferencia de carga, la cual traslada la carga recolectada en cada pixel hacia los amplificadores de salida. Este proceso se realiza mediante la variación del voltaje aplicado a los electrodos de cada pixel del detector. Parámetros de las señales de lectura tales como la excursión de voltaje, tiempos de subida/bajada y tasa de subida/bajada, se relacionan en forma directa con el desempeño del proceso de transferencia de carga. Si consideramos la naturaleza capacitiva de los pixeles del CCD, los drivers de generación de señales de lectura existentes no son eficaces, debido a que el control de la forma de onda se realiza mediante un amplificador de voltaje. Esta arquitectura de control no permite establecer con precisión la tasa de subida/bajada de la señal de voltaje, ya que su establecimiento siempre respetará la respuesta dinámica del amplificador. Este trabajo estudia y propone el uso de la fuente de corriente de Howland mejorada para generar las señales de reloj para la lectura de los CCDs. Esta idea aprovecha la característica capacitiva de los pixeles del CCD, lo que permite establecer con precisión la tasa de subida/bajada de las señales de lectura, y en consecuencia, mejorar el desempeño del proceso de transferencia de carga.

**Tesista: Divanach, Mathilde.**
**Tesis: "Plantas fotovoltaicas para la municipalidad de providencia. Estudios de pre-factibilidad".**
Supervisor: Prof. Juan Dixon
Fecha de la defensa: 03-03-2016
Resumen:
En el presente estudio, se busca analizar la factibilidad de dos proyectos de plantas fotovoltaicas para recintos de la Municipalidad de Providencia. Para cumplir con este objetivo, para ambos recintos se estudian los aspectos siguientes: dimensionamiento de la planta fotovoltaica según las características del edificio, evaluación financiera del proyecto, y análisis de riesgo y de la factibilidad eléctrica y estructural. Para la Dirección de Administración y Finanzas (DAF), se concluye que se puede instalar una planta fotovoltaica de 34 kWp, lo que permite compensar el consumo energético anual del recinto y obtener un balance <<cero emisión>>. Este proyecto es rentable del punto de vista social. Además, se recomienda permitir la entrega de energía hacia la red pública, y conectar la planta al tablero eléctrico general. En el Cafe Literario Bustamante es factible instalar una planta fotovoltaica de 8,75 kWp. Sin embargo, la evaluación financiera muestra que no es rentable el proyecto. Se recomienda

considerar de nuevo el proyecto cuando las condiciones técnicas y económicas permitan obtener un precio de inversión reducido de un tercio

**Tesista: Durán Flores, Pablo.**
**Tesis: "Evaluación del impacto tecno-económico del niño-oscilación del sur en el recurso eólico de Chile".**
Supervisor: Prof. David Watts
Fecha de la defensa: 18-01-2016
Resumen:
Este trabajo evalúa el impacto de El Niño-Oscilación del Sur (ENOS) en la velocidad del viento, la producción energética, así como también su impacto en el valor de proyectos eólicos potenciales en diferentes sitios a lo largo de Chile. Se aplica el análisis de funciones empíricas ortogonales cicloestacionarias (CSEOF) para aislar la influencia de ENOS en la velocidad del viento y a partir de esto, la influencia en la producción de energía de los parques cercanos, potenciales y existentes, de los sitios analizados en Chile. Se detalla paso a paso la aplicación de la descomposición CSEOF, la cual permite mostrar la evolución temporal de ENOS y de la variabilidad interanual (Modulated Annual Cycle o MAC) como proceso físico. Para traducir la variabilidad en la velocidad del viento mensual en variabilidad de la producción de energía, se propone una curva de potencia mensual basada en la estadística de producción horaria, lo que permite calcular la producción mensual a partir de la media mensual de la velocidad del viento. Finalmente, una revisión de los parámetros tecno-económicos es hecha con el objetivo de modelar el impacto económico de la ocurrencia de un evento de ENOS en un determinado año de la vida de un proyecto. La principal contribución de este trabajo es demostrar que los eventos de La Niña y El Niño son un factor muy importante para la planificación del sistema, para la predicción del potencial eólico en algunas zonas del país y para la evaluación del riesgo en proyectos situados en esas zonas.

**Tesista: Henríquez Auba, Rodrigo Martí.**
**Tesis: "Participación de un agregador de respuesta de demanda en mercados eléctricos: Manejo óptimo de contratos".**
Supervisor: Prof. Matías Negrete; Daniel Olivares
Fecha de la defensa: 05-10-2016
Resumen:
La respuesta de demanda (DR) es una forma versátil para proveer flexibilidad a los sistemas eléctricos de potencia. Para poder manejar la flexibilidad asociada a la gran cantidad de recursos de DR distribuidos, en el contexto de los mercados eléctricos, estos deben ser agregados por un nuevo participante denominado agregador de respuesta de demanda. En este trabajo se presenta un modelo de optimización para determinar la operación óptima de un agregador de DR que maneja un portafolio de programas de DR que le permiten participar en los mercados mayoristas de electricidad. El agregador es considerado como un participante estratégico en el mercado de tiempo real. El portafolio de recursos de DR está compuesto por varios contratos de desprendimiento de carga y cargas flexibles que pueden ser ejecutadas para modificar la demanda agregada hora a hora. La incertidumbre de los precios de mercado y los requerimientos de balance son representados a través de un conjunto de escenarios basados en datos históricos. El modelo propuesto es un programa matemático binivel estocástico, que

puede ser reformulado como un programa lineal-entero mixto (MILP). Diversos casos de estudios con resultados numéricos son presentados.

**Tesista: Jara Toro, Matías Ignacio.**
**Tesis: “Passive reference-sharing SAR ADC for ultra low power applications”.**
Supervisor: Prof. Angel Abusleme
Fecha de la defensa: 25-01-2016
Abstract:
The passive reference-sharing (PRS) is a novel topology for successive approximation register (SAR) analog-to-digital converters (ADC) that employs equally sized capacitors in the digital-to-analog converter (DAC) array. This characteristic allows a smaller die area and high energy efficient operation for medium resolution converters. A complete review of a PRS SAR ADC is presented in this work, analyzing its design-space and performance bounds. Based on the analysis, an optimized design for an 8-bit ADC is proposed and implemented using a 0.13µm technology process, with a die area of 0.024 $mm^2$. Post-layout simulations results report a figure of merit (FOM) of 35.4 f J/conv-step, an effective number of bits (ENOB) of 7.32 bits, and a power consumption of 11.78µW at a sampling rate of 2.08 MS/s. This features make the proposed design suitable for ultra low power applications, such as wireless sensor nodes and biomedical devices. Finally, a chip was submitted for fabrication to measure the actual performance of the proposed converter.

**Tesista: Lopez-Estevez Guerra, Matías José.**
**Tesis: "On the use of fuzzy real option hybrid simulation: analysis and interpretation".**
Supervisor: Prof. Daniel Olivares
Fecha de la defensa: 18-11-2016
Abstract:
Fuzzy real options involve solving real options that consider a single or multiple fuzzy variables as parameters. In this paper, we propose a methodology to process, display, and interpret fuzzy-random results of a fuzzy real option hybrid simulation. A step-by-step application to evaluate risky projects is outlined. Real option values are estimated by Least Squares Monte Carlo simulation, capturing the value of managerial flexibility in a project's course of action. Different metrics such as expected value, conditional value at risk, and cumulative probabilities of the real option value are estimated via possibility distributions and their corresponding fuzzy expected values. This action, together with displaying results by different confidence levels referring to the experts' opinion accuracy, gives the decision maker convenient information to base his judgments in accordance with a given commercial strategy and risk aversion policy. We illustrate the applicability and suitability of the framework by applying it to the evaluation of a hydropower plant project.

**Tesista: Piña Abarca, Alfonso Andrés.**
**Memoria: "Los contratos de gas y su interacción con las energías renovables intermitentes en el Sistema Interconectado del Norte Grande".**
Guía: Prof. Hugh Rudnick
Fecha de la defensa: 12-04-2016
Resumen:
La creciente tendencia mundial por el aumento en las penetraciones de generación renovable, en especial la generación solar y eólica, como fuentes intermitentes, exige que los sistemas se adapten a su operación. El incremento de estas fuentes en la matriz energética de los sistemas eléctricos eleva los requerimientos de flexibilidad del sistema e incrementa el cycling de las unidades térmicas como el carbón y el gas. Junto a esto se tiene que en Chile, al ser un país importador neto de energía, las centrales a gas deben establecer contratos de suministro de gas del tipo take or pay de largo plazo para asegurar la disponibilidad del combustible. Así, ante penetraciones renovables intermitentes crecientes es importante considerar los costos de dichos contratos y las consecuentes restricciones y obligaciones de consumo en el modelo de unit commitment. En este trabajo se realiza una revisión bibliográfica de la problemática asociada y una contextualización del mercado eléctrico chileno para proponer y desarrollar un modelo matemático que permita simular la interacción de estas distintas tecnologías. Se simula la operación del Sistema Interconectado del Norte Grande (SING) en un año bajo una modelación de unit commitment estocástico considerando cuatro sub-modelos: efectos de los precios declarados, no inclusión de contratos de gas, inclusión de contratos inflexibles e inclusión de contratos flexibles. Se adoptó un esquema de modelación por estados que permite reducir los requerimientos computacionales de la resolución del problema. Los resultados muestran que la consideración de contratos de gas en el modelo reduce los costos operacionales de corto plazo así como cuando se aumenta la flexibilidad de los contratos.

**Tesista: Wenzel Acuña, George Alfons.**
**Tesis: "Real-Time strategies for an electric vehicle aggregator to provide ancillary services".**
Supervisor: Prof. Daniel Olivares – Matías Negrete
Fecha de la defensa: 01-08-2016
Abstract:
Real-time charging strategies, in the context of vehicle to grid (V2G) technology, are needed to enable the use of electric vehicle (EV) fleets batteries to provide ancillary services (AS). In this work we develop tools to manage charging and discharging in a fleet to track an Automatic Generation Control (AGC) signal when aggregated. We propose a real-time controller based on convex optimization, that considers bidirectional charging efficiency, and extend it to study the effect of looking ahead when implementing Model Predictive Control (MPC). Different complexity levels are introduced to the controller, by using approximations and/or relaxations, which hold under sufficient conditions that are provided. Simulations show that more complex controllers improve tracking error as compared with benchmark scheduling algorithms, as well as regulation capacity and battery cycling impacts. However, they face a trade-off between ease of implementation and performance.

## III. MEMORISTAS TITULADOS DE INGENIERO CIVIL

**Memorista: Divanach, Mathilde.**
**Tesis: "Plantas fotovoltaicas para la municipalidad de Providencia. Estudios de pre-factibilidad".**
Supervisor: Prof. Juan Dixon
Fecha de la defensa: 03-03-2016.
Resumen:
En el presente estudio, se busca analizar la factibilidad de dos proyectos de plantas fotovoltaicas para recintos de la Municipalidad de Providencia. Para cumplir con este objetivo, para ambos recintos se estudian los aspectos siguientes: dimensionamiento de la planta fotovoltaica según las características del edificio, evaluación financiera del proyecto, y análisis de riesgo y de la factibilidad eléctrica y estructural. Para la Dirección de Administración y Finanzas (DAF), se concluye que se puede instalar una planta fotovoltaica de 34 kWp, lo que permite compensar el consumo energético anual del recinto y obtener un balance <<cero emisión>>. Este proyecto es rentable del punto de vista social. Además, se recomienda permitir la entrega de energía hacia la red pública, y conectar la planta al tablero eléctrico general. En el Cafe Literario Bustamante es factible instalar una planta fotovoltaica de 8,75 kWp. Sin embargo, la evaluación financiera muestra que no es rentable el proyecto. Se recomienda considerar de nuevo el proyecto cuando las condiciones técnicas y económicas permitan obtener un precio de inversión reducido de un tercio

**Memorista: Gallegos Garay, Pablo Ignacio.**
**Memoria: "Arquitectura de control y comunicaciones para la implementación de respuesta de la demanda residencial".**
Guía: Prof. Matías Negrete
Fecha de la defensa: 2016
Resumen:
En este trabajo se analizó la problemática comunicacional de un servicio de respuesta de la demanda residencial. Mediante la figura del agregador, ente articulador que permite la transferencia de recursos de respuesta de la demanda desde los clientes finales hacia el sistema eléctrico, se abordaron dos preguntas esenciales: cuáles son las tecnologías que habilitan al agregador a prestar servicios de respuesta de la demanda y cómo desarrollar una arquitectura de comunicación para tales fines. En función de estas preguntas se dividió el trabajo en dos partes.
En la primera parte se analizaron desde un punto de vista comunicacional y teórico, diferentes tecnologías propuestas en la literatura para servicios de respuesta de la demanda, y se contrastaron con los diferentes servicios en los que un agregador puede participar: mercados de energía y servicios complementarios. Se determinó que, para participación en mercados de electricidad, cualquiera de las tecnologías propuestas otorga la suficiente holgura para su participación. En particular, para que un agregador pueda realizar una oferta de reducción de carga de 100 kW se estima no más de un segundo de retardo entre todas las tecnologías evaluadas. Asimismo, se determinó que en un contexto de servicios complementarios todas las tecnologías presentan suficiente amplitud para prestar dichos servicios. En efecto, se calcularon

no más de algunos milisegundos de retardo. En la segunda parte se diseña una arquitectura comunicacional para un agregador. Esta arquitectura se desarrolló mediante Smart Grid Architecture Model (SGAM), el cual entrega un marco teórico para el desarrollos sistemático en un contexto de redes inteligentes. El resultado es un modelo de cinco capas que disgrega todo el servicio en sus componentes informáticas, comunicacionales, físicas, funcionales y de negocio.

**Memorista: Marfan Rojas, Sofía Lucía de Lourdes.**
**Memoria: "ANALOG/DIGITAL LAB TRAINER: Aplicaciones de la Ingeniería al** aprendizaje de la electrónica".
Guía: Prof. Angel Abusleme
Fecha de la defensa: 28-12-2016
Resumen:
La enseñanza de la electrónica está comenzado de manera temprana, incluso a nivel escolar, gracias al avance de esta disciplina que año a año experimenta grandes progresos. Las nuevas generaciones están cada vez más conectadas con las nuevas tecnologías. En Chile, actualmente es difícil enseñar fundamentos de electrónica en colegios debido a la falta de profesores especialistas y al riesgo que conlleva trabajar con electricidad. Por esto, en este trabajo se propone resolver el problema mediante el concepto de Lab Trainer. Su diseño electrónico simple, modular y open source, permitirá a que profesores puedan motivar a sus alumnos con experiencias en electrónica virtualmente sin riesgos. Lab Trainer es un dispositivo para el trabajo en laboratorio que permite al usuario interactuar de forma didáctica con la electrónica ya que el dispositivo tiene un diseño sin carcasa que permite ver y tocar los componentes haciéndolo mucho más atractivo que otras alternativas. En este trabajo se detalla paso a paso cómo fue diseñado e implementado el Lab Trainer. Se espera probar este dispositivo con niños para acercarlos a la electrónica e incluso quizás impulsar una campaña para introducir el dispositivo en colegios.

**Memorista: Retamales Ortega, Francisco José.**
**Memoria: "Diseño de dispositivo de presencia virtual para personas con discapacidad motora severa".**
Guía: Prof. Miguel Torres
Fecha de la defensa: 2016
Resumen:
Debido a la falta de autonomía y la dificultad de tener interacciones sociales, las personas que poseen discapacidades físicas poseen generalmente una calidad de vida disminuida. En el presente documento se describe el desarrollo de una plataforma móvil de bajo costo que es capaz de asistir a personas en situación de discapacidad motora severa en la interacción social de forma independiente. Para la plataforma se necesitó desarrollar una plataforma móvil inalámbrica; adaptar dos dispositivos de interacción, una cámara y un seguidor ocular; y desarrollar un programa que integra todo para su fácil uso. Además, se realizaron pruebas a usuarios de distinto rango etario, como también a personas con y sin discapacidad para poder validar la plataforma. En conclusión, como primera instancia de validación se puede afirmar que la plataforma de bajo costo cumple con la funcionalidad de ayuda en la interacción social,

pero que se necesita un mayor desarrollo en el software de integración si se desea que niños también la utilicen.

**Memorista: Sacaan Amunátegui, Rafael Andrés.**
**Memoria: "Emulación de una etapa de ganancia de cátodo común con triodo 12AX7 mediante bloques circuitales análogos y discretos".**
Guía: Prof. Angel Abusleme
Fecha de la defensa: 2016
Resumen:
La presente investigación tiene por objetivo caracterizar la salida de una etapa deganancia de cátodo común con triodo 12AX7 describiendo los fenómenos de nolinealidad presentes en todas sus regiones de operación. El foco de la investigación secentra sobre el contenido armónico de la señal de salida, lo que se traduce en unadeterminada sonoridad del amplificador. En segundo lugar, se buscará describir circuitosemuladores de una etapa de ganancia con triodo que utilicen componentes análogos ydiscretos para posteriormente proponer un circuito emulador mejorado. Se procederá a describir una etapa de ganancia de cátodo común con triodo identificandocuatro regiones de operación, las que marcan un hito sobre el comportamiento de los armónicos generados en la medida que aumenta una señal de entrada. Se describirá la relación de éstos con la forma de onda y amplitud de ésta entre otros parámetros relevantes. Finalmente se propondrá un circuito simple emulador de triodo y se irá profundizando su funcionalidad hasta llegar a un emulador adecuado y original. Se concluye que si bien hay efectos fundamentales de un triodo que son difíciles de emular, con circuitos análogos y discretos es posible llegar a buen puerto cuando se considera como referencia el contenido armónico de una señal de salida, lo que puede ser corroborado perceptivamente y de forma auditiva. El circuito propuesto presenta la potencialidad de seguir siendo estudiado más en profundidad a partir de la información entregada en esta memoria.

## IV. PUBLICACIONES EN REVISTAS ISI

**Abusleme A., Bélanger-Champagne C., Bellerive A., Benhammou Y., Botte J., Cohen H., Davies M., Du Y., Gauthier L., Koffas T., Kuleshov S., Lefebvre B., Li C., Lupu N., Mikenberg G., Mori D., Ochoa-Ricoux J.P., Perez Codina E., Rettie S., Robichaud-Véronneau A., Rojas R., Shoa M., Smakhtin V., Stelzer B., Stelzer-Chilton O., Toro A., Torres H., Ulloa P., Vachon B., Vásquez G., Vdovin A., Viel S., Walker P., Weber S., Zhu C. (2016) Performance of a full-size small-strip thin gap chamber prototype for the ATLAS new small wheel muon upgrade. Nuclear Instruments & Methods in Physics Research Section A-Accelerators Spectrometers Detectors and Associated Equipment. 817, 85-92.**

Abstract:
The instantaneous luminosity of the Large Hadron Collider at CERN will be increased up to a factor of five with respect to the present design value by undergoing an extensive upgrade program over the coming decade. The most important upgrade project for the ATLAS Muon System is the replacement of the present first station in the forward regions with the so-called New Small Wheels (NSWs). The NSWs will be installed during the LHC long shutdown in 2018/19. Small-Strip Thin Gap Chamber (sTGC) detectors are designed to provide fast trigger and high precision muon tracking under the high luminosity LHC conditions. To validate the design, a full-size prototype sTGC detector of approximately 1.2 × 1.0m2 consisting of four gaps has been constructed. Each gap provides pad, strip and wire readouts. The sTGC intrinsic spatial resolution has been measured in a 32GeV pion beam test at Fermilab. At perpendicular incidence angle, single gap position resolutions of about 50μm have been obtained, uniform along the sTGC strip and perpendicular wire directions, well within design requirements. Pad readout measurements have been performed in a 130GeV muon beam test at CERN. The transition region between readout pads has been found to be 4mm, and the pads have been found to be fully efficient.

**Aguilera-Marinovic S., Torres M., Auat-Cheein F., (2016) Development of a long-stroke MR damper for a building with tuned masses. IEEE-ASME Transactions on Mechatronics. 25, 10, 17.**

Abstract:
The design of motion controllers that could reduce terrain disturbances propagated to the arm and optimize the trajectories of skid-steer mobile manipulators working in agricultural, construction or mining environments requires accurate physical models capable of correctly representing disturbances caused by changes in terrain slope, loss of traction and other wheel-ground interactions. Therefore, the present work develops the forward dynamics equations of motion and proposes a general model for skid-steer mobile manipulators. The novelty of the model is that it considers a floating-base with non-permanent wheel-ground contacts, i.e. the mobile base has 6-DOF and the wheels may lose contact with the terrain. Unlike the existing models, the proposed one is general because the procedure can be extended to mobile manipulators with an arbitrary number of arms or wheels and does not restrict the mobile base

to planar 2D motions. Furthermore, it takes into account the loss of traction and the deformation of the wheel-ground contacts. The experimental results involving a small skid-steer mobile manipulator with a 3-DOF arm and an industrial skid-steer loader validate the physical fidelity of the model. Although the focus of this paper is not in control aspects, one of the examples shows the role physically accurate models can have in the design of end-effector motion controllers, and its potential application to the design of controllers capable of decoupling the arm motion from ground disturbances.

**Aguilera-Marinovic S., Torres M., Auat-Cheein F., (2016) General dynamic model for skid-steer mobile manipulators with wheel-ground interactions. IEEE-ASME Transactions on Mechatronics.**

Abstract:
The design of motion controllers that could reduce terrain disturbances propagated to the arm and optimize the trajectories of skid-steer mobile manipulators working in agricultural, construction or mining environments requires accurate physical models capable of correctly representing disturbances caused by changes in terrain slope, loss of traction and other wheel-ground interactions. Therefore, the present work develops the forward dynamics equations of motion and proposes a general model for skid-steer mobile manipulators. The novelty of the model is that it considers a floating-base with non-permanent wheel-ground contacts, i.e. the mobile base has 6-DOF and the wheels may lose contact with the terrain. Unlike the existing models, the proposed one is general because the procedure can be extended to mobile manipulators with an arbitrary number of arms or wheels and does not restrict the mobile base to planar 2D motions. Furthermore, it takes into account the loss of traction and the deformation of the wheel-ground contacts. The experimental results involving a small skid-steer mobile manipulator with a 3-DOF arm and an industrial skid-steer loader validate the physical fidelity of the model. Although the focus of this paper is not in control aspects, one of the examples shows the role physically accurate models can have in the design of end-effector motion controllers, and its potential application to the design of controllers capable of decoupling the arm motion from ground disturbances.

**Alessandri C., Abusleme A., Guzmán C., Passalacqua I., Álvarez-Fontecilla E., Guarini M. (2016) Optimal CCD readout by digital correlated double sampling. Monthly Notices of the Royal Astronomical Society. 455, 2, 1443-1450.**

Abstract:
Digital correlated double sampling (DCDS), a readout technique for charge-coupled devices (CCD), is gaining popularity in astronomical applications. By using an oversampling ADC and a digital filter, a DCDS system can achieve a better performance than traditional analogue readout techniques at the expense of a more complex system analysis. Several attempts to analyse and optimize a DCDS system have been reported, but most of the work presented in the literature has been experimental. Some approximate analytical tools have been presented for independent parameters of the system, but the overall performance and trade-offs have not been yet modelled. Furthermore, there is disagreement among experimental results that cannot be explained by the analytical tools available. In this work, a theoretical analysis of a generic DCDS readout system is presented, including key aspects such as the signal conditioning stage, the ADC resolution, the sampling frequency and the digital filter implementation. By using a

time-domain noise model, the effect of the digital filter is properly modelled as a discrete-time process, thus avoiding the imprecision of continuous-time approximations that have been used so far. As a result, an accurate, closed-form expression for the signal-to-noise ratio at the output of the readout system is reached. This expression can be easily optimized in order to meet a set of specifications for a given CCD, thus providing a systematic design methodology for an optimal readout system. Simulated results are presented to validate the theory, obtained with both time- and frequency-domain noise generation models for completeness.

**Arab J.P., Barrera F., Gallego C., Valderas J.P., Uribe S., Tejos C., Serrano C., Huete Á., Liberona J., Labbé P., Quiroga T., Benítez C., Irarrázaval P., Riquelme A., Arrese M., (2016) High prevalence of undiagnosed liver cirrhosis and advanced fibrosis in type 2 diabetic patients. Annals of Hepatology. 15, 5, 721-728.**

Abstract:
Background. Patients with type 2 diabetes mellitus (T2DM) are at risk for developing end-stage liver disease due to nonalcoholic steatohepatitis (NASH), the aggressive form of non-alcoholic fatty liver disease (NAFLD). Data on prevalence of advanced fibrosis among T2DM patients is scarce. Aim. To evaluate prevalence of steatosis, advanced fibrosis and cirrhosis using non-invasive methods in T2DM patients. Material and methods. 145 consecutive T2DM patients (> 55 years-old) were prospectively recruit- ed. Presence of cirrhosis and advanced fibrosis was evaluated by magnetic resonance imaging (MRI) and NAFLD fibrosis score (NFS) respectively. Exclusion criteria included significant alcohol consumption, markers of viral hepatitis infection or other liver dis- eases. Results are expressed in percentage or median (interquartile range). Results. 52.6% of patients were women, the median age was 60 years old (57-64), mean BMI was 29.6 ± 4.7 kg/m2 and diabetes duration was 7.6 ± 6.9 years. A high prevalence of liv- er steatosis (63.9%), advanced fibrosis assessed by NFS (12.8%) and evidence of liver cirrhosis in MRI (6.0%) was observed. In a multivariate analysis GGT > 82 IU/L (P = 0.004) and no alcohol intake (P = 0.032) were independently associated to advanced fibrosis. Conclusion. A high frequency of undiagnosed advanced fibrosis and cirrhosis was observed in non-selected T2DM patients. Screening of these conditions may be warranted in this patient population.

**Arboleda C., Aguirre-Reyes D., García M.P., Tejos C., Muñoz L., Miquel J.F., Irarrázaval P., Andia M.E., Uribe S., (2016) Total liver fat quantification using three-dimensional respiratory self-navigated MRI sequence. Magnetic Resonance Imaging. 76, 5, 1400-1409.**

Abstract:
Purpose MRI can produce quantitative liver fat fraction (FF) maps noninvasively, which can help to improve diagnoses of fatty liver diseases. However, most sequences acquire several two-dimensional (2D) slices during one or more breath-holds, which may be difficult for patients with limited breath-holding capacity. A whole-liver 3D FF map could also be obtained in a single acquisition by applying a reliable breathing-motion correction method. Several correction techniques are available for 3D imaging, but they use external devices, interrupt acquisition, or jeopardize the spatial resolution. To overcome these issues, a proof-of-concept study introducing a self-navigated 3D three-point Dixon sequence is presented here. Methods A respiratory self-gating strategy acquiring a center k-space profile was integrated into a three-

point Dixon sequence. We obtained 3D FF maps from a water-fat emulsions phantom and fifteen volunteers. This sequence was compared with multi-2D breath-hold and 3D free-breathing approaches. Results Our 3D three-point Dixon self-navigated sequence could correct for respiratory-motion artifacts and provided more precise FF measurements than breath-hold multi-2D and 3D free-breathing techniques. Conclusion Our 3D respiratory self-gating fat quantification sequence could correct for respiratory motion artifacts and yield more-precise FF measurements.

**Arnold D.B., Negrete-Pincetic M., Sankur M.D., Auslander D.M., Callaway D.S. (2016) Model-free optimal control of VAR resources in distribution systems: an extremum seeking approach. IEEE Transactions on Power Systems. no.99, pp.1-11.**

Abstract**:**
Distributed power electronic reactive power sources—such as smart PV inverters—may play an important role in regulating customer voltages and reducing system losses in future distribution systems. Though it is natural to consider model-based optimal control algorithms to coordinate these resources, those strategies typically require relatively large communications capabilities and accurate models. In this paper we present an alternative way to implement the optimization problem that circumvents these communications and modeling challenges. We present an Extremum Seeking (ES) control algorithm to modulate the reactive power output of VAR resources to minimize total real power delivery at the feeder substation subject to voltage magnitude constraints, without an explicit feeder model. We present results that guarantee a variety of distribution feeder objective functions are convex over a broad range of power flows and perform an analysis showing the convergence of the ES approach. Simulation results demonstrate that the method is equivalent to recently developed convex relaxations used to solve distribution optimal power flow problems.

**Auat F.A., Scaglia G., Torres M., Guivant J., Prado A.J., Arno J., Escola A., Rosell-Polo J.R. (2016) Algebraic path tracking to aid the manual harvesting of olives using an automated service unit. Biosystems Engineering. 142, 117–132.**

Abstract:
Service units used in precision agriculture are able to improve processes such as harvesting, sowing, agrochemical application, and manure spreading. This two-part work presents, a path tracking controller based on an algebraic approach for an articulated service unit, suitable for embedded applications, and its implementation to a hierarchical navigation strategy to aid a manual harvesting process. The path tracking controller approach can be scaled to several trailers attached to the service unit. For harvesting, the service unit drives within an olive grove environment following the previously developed path and a trailer is used as a mobile hopper where olives, collected by human labour, are deposited. The service unit also registers and geo-references the amount of olives (mass) collected for the subsequent creation of yield maps. The developed navigation strategy improved the time associated with harvesting olives by approximately 42–45%. The mathematical formulation of the problem, some real time experimental results, the creation of a yield map and the statistical analysis that validated the method are included.

**Basden A.G., Atkinson D., Bharmal N.A., Bitenc U., Brangier M., Buey T., Butterley T., Cano D., Chemla F., Clark P., Cohen M., Conan J.-M., de Cos F. J., Dickson C., Dipper N.A., Dunlop C.N., Feautrier P., Fusco T., Gach J.L., Gendron E., Geng D., Guesalaga A., Guzmán C., (2016) Experience with wavefront sensor and deformable mirror interfaces for wide-field adaptive optics systems. Monthly Notices of the Royal Astronomical Society. 459, 2, 1350-1359**.

Abstract:
Recent advances in adaptive optics (AO) have led to the implementation of wide field-of-view AO systems. A number of wide-field AO systems are also planned for the forthcoming Extremely Large Telescopes. Such systems have multiple wavefront sensors of different types, and usually multiple deformable mirrors (DMs). Here, we report on our experience integrating cameras and DMs with the real-time control systems of two wide-field AO systems. These are CANARY, which has been operating on-sky since 2010, and DRAGON, which is a laboratory AO real-time demonstrator instrument. We detail the issues and difficulties that arose, along with the solutions we developed. We also provide recommendations for consideration when developing future wide-field AO systems.

**Bronfman A., Marianov V., Paredes-Belmar G., Lüer-Villagra A., (2016) The maxisum and maximin-maxisum HAZMAT routing problems. Transportation Research Part E-Logistics and Transportation Review. 3, 316–333.**

Abstract:
We design routes for transportation of hazardous materials (HAZMAT) in urban areas, with multiple origin-destination pairs. First, we introduce the maxisum HAZMAT routing problem, which maximizes the sum of the population-weighted distances from vulnerable centers to their closest point on the routes. Secondly, the maximin-maxisum HAZMAT routing problem trades-off maxisum versus the population-weighted distance from the route to its closest center. We propose efficient IP formulations for both NP-Hard problems, as well as a polynomial heuristic that reaches gaps below 0.54% in a few seconds on the real case in the city of Santiago, Chile.

**Bluhm P. , Jones M. I., Vanzi L., Soto M. G., Vos J., Wittenmyer R. A., Drass H., Jenkins4, F. Olivares J. S., Mennickent R. E., Vučković M., Rojo P. and Melo C. H. F. (2016) New spectroscopic binary companions of giant stars and updated metallicity distribution for binary systems. Astronomy and Astrophisycs, Volume 593, A133.**

Abstract:
We report the discovery of 24 spectroscopic binary companions to giant stars. We fully constrain the orbital solution for 6 of these systems. We cannot unambiguously derive the orbital elements for the remaining stars because the phase coverage is incomplete. Of these stars, 6 present radial velocity trends that are compatible with long-period brown dwarf companions. The orbital solutions of the 24 binary systems indicate that these giant binary systems have a wide range in orbital periods, eccentricities, and companion masses. For the binaries with restricted orbital solutions, we find a range of orbital periods of between ~97–1600 days and eccentricities of between ~0.1–0.4. In addition, we studied the metallicity distribution of single and binary giant stars. We computed the metallicity of a total of 395 evolved stars, 59 of wich are in binary systems. We find a flat distribution for these binary stars and therefore conclude that stellar binary systems, and potentially brown dwarfs, have a

different formation mechanism than planets. This result is confirmed by recent works showing that extrasolar planets orbiting giants are more frequent around metal-rich stars. Finally, we investigate the eccentricity as a function of the orbital period. We analyzed a total of 130 spectroscopic binaries, including those presented here and systems from the literature. We find that most of the binary stars with periods $\lesssim$30 days have circular orbits, while at longer orbital periods we observe a wide spread in their eccentricities.

**Cruz G., Atkinson D., Buerger C., Schaeffter T., Prieto C. (2016) Accelerated motion corrected three-dimensional abdominal MRI using total variation regularized SENSE reconstruction. Magnetic Resonance in Medicine. 75, 4, 1484-1498.**

Abstract:
Purpose: Develop a nonrigid motion corrected reconstruction for highly accelerated free-breathing three-dimensional (3D) abdominal images without external sensors or additional scans. Methods: The proposed method accelerates the acquisition by undersampling and performs motion correction directly in the reconstruction using a general matrix description of the acquisition. Data are acquired using a self-gated 3D golden radial phase encoding trajectory, enabling a two stage reconstruction to estimate and then correct motion of the same data. In the first stage total variation regularized iterative SENSE is used to reconstruct highly undersampled respiratory resolved images. A nonrigid registration of these images is performed to estimate the complex motion in the abdomen. In the second stage, the estimated motion fields are incorporated in a general matrix reconstruction, which uses total variation regularization and incorporates k-space data from multiple respiratory positions. The proposed approach was tested on nine healthy volunteers and compared against a standard gated reconstruction using measures of liver sharpness, gradient entropy, visual assessment of image sharpness and overall image quality by two experts.Results: The proposed method achieves similar quality to the gated reconstruction with nonsignificant differences for liver sharpness (1.18 and 1.00, respectively), gradient entropy (1.00 and 1.00), visual score of image sharpness (2.22 and 2.44), and visual rank of image quality (3.33 and 3.39). An average reduction of the acquisition time from 102 s to 39 s could be achieved with the proposed method.Conclusion: In vivo results demonstrate the feasibility of the proposed method showing similar image quality to the standard gated reconstruction while using data corresponding to a significantly reduced acquisition time.

**Cruz G., Atkinson D., Henningsson M., Botnar R. Prieto C. (2016) Highly efficient nonrigid motion-corrected 3D whole-heart coronary vessel wall imaging. Magnetic Resonance in Medicine.**

**Abstract:**
Purpose: To develop a respiratory motion correction framework to accelerate free-breathing three-dimensional (3D) whole-heart coronary lumen and coronary vessel wall MRI. Methods: We developed a 3D flow-independent approach for vessel wall imaging based on the subtraction of data with and without T2-preparation prepulses acquired interleaved with image navigators. The proposed method corrects both datasets to the same respiratory position using beat-to-beat translation and bin-to-bin nonrigid corrections, producing coregistered, motion-corrected coronary lumen and coronary vessel wall images. The proposed method was studied in 10 healthy subjects and was compared with beat-to-beat translational correction (TC) and no

motion correction for the left and right coronary arteries. Additionally, the coronary lumen images were compared with a 6-mm diaphragmatic navigator gated and tracked scan. Results: No significant differences ($P > 0.01$) were found between the proposed method and the gated and tracked scan for coronary lumen, despite an average improvement in scan efficiency to 96% from 59%. Significant differences ($P < 0.01$) were found in right coronary artery vessel wall thickness, right coronary artery vessel wall sharpness, and vessel wall visual score between the proposed method and TC. Conclusion: The feasibility of a highly efficient motion correction framework for simultaneous whole-heart coronary lumen and vessel wall has been demonstrated.

**de la Llera J., Rivera F., Mitrani-Reiser J., Junemann R., Fortuño C., Ríos M., Hube M., Santa María H., Cienfuegos R. (2016) Data collection after the 2010 Maule earthquake in Chile. Bulletin of Earthquake Engineering.**

Abstract**:**
This article presents an overview of the different processes of data recollection and the analysis that took place during and after the emergency caused by the Mw 8.8 2010 Maule earthquake in central-south Chile. The article is not an exhaustive recollection of all of the processes and methodologies used; it rather points out some of the critical processes that took place with special emphasis in the earthquake characterization and building data. Although there are strong similarities in all of the different data recollection processes after the earthquake, the evidence shows that a rather disaggregate approach was used by the different stakeholders. Moreover, no common standards were implemented or used, and the resulting granularity and accuracy of the data was not comparable even for similar structures, which sometimes led to inadequate decisions. More centralized efforts were observed in resolving the emergency situations and getting the country back to normal operation, but the reconstruction process took different independent routes depending on several external factors and attitudes of individuals and communities. Several conclusions are presented that are lessons derived from this experience in dealing with a large amount of earthquake data. The most important being the true and immediate necessity of making all critical earthquake information available to anyone who seeks to study such data for a better understanding of the earthquake and its consequences. By looking at the information provided by all these data, we aim to finally improve seismic codes and engineering practice, which are important social goods.

**De Sá Ferreira R., Rudnick H., Barroso L. (2016) The Expansion of Transmission: The Challenges Faced in South America. IEEE Power & Energy Magazine. 14, 4, 54-64.**

Abstract**:**
Transmission system expansion boomed in several South American countries in the 2000s and the early 2010s. Network capacity additions were required to cope with fast-growing electricity demand, prompted by average gross domestic product growth rates of around 5% per year in 2003?2008 and 3% per year in 2008-2013. Following a trend verified in most infrastructure segments, private sector participation in transmission investments increased significantly in the period, which was the result of reforms in the electricity industry that had initiated in the 1990s.

**Drezner Z., Marianov V., Wesolowsky G.O., (2016) Maximizing the minimum cover probability by emergency facilities. Annals of Operations Research. 246, 1, 349-362.**

Abstract:
In this paper we propose a stochastic model for the location of emergency facilities. The model is formulated and analyzed. The location of one facility in the plane is optimally solved. Optimal algorithms are proposed for the location of multiple facilities on a network. Computational experiments illustrate the effectiveness of these solution procedures.

**Espinoza S. Panteli M. Mancarella P. Rudnick H. (2016) Multi-phase assessment and adaptation of power systems resilience to natural hazards. Electric Power Systems Research. 136, pp. 352-361.**

Abstract:
Extreme weather hazards, as high-impact low-probability events, have catastrophic consequences on critical infrastructures. As a direct impact of climate change, the frequency and severity of some of these events is expected to increase in the future, which highlights the necessity of evaluating their impact and investigating how can systems withstand a major disruption with limited degradation and recover rapidly. This paper first presents a multi-phase resilience assessment framework that can be used to analyze any natural threat that may have a severe single, multiple and/or continuous impact on critical infrastructures, such as electric power systems. Namely, these phases are (i) threat characterization, (ii) vulnerability assessment of the system's components, (iii) system's reaction and (iv) system's restoration. Second, multi-phase adaptation cases, i.e. making the system more robust, redundant and responsive are explained to discuss different strategies to enhance the resilience of the electricity network. To illustrate the above, this time-dependent framework is applied to assess the impact of potential future windstorms and floods on a reduced version of the Great Britain's power network. Finally, the adaptation cases are evaluated to conclude in what situations a stronger, bigger or smarter grid is preferred against the uncertain future.

**González, R. Cipriano A., (2016) An Insulin Infusion Fuzzy Controller with State Estimation for Artificial Pancreas Systems. Revista Iberoamericana de Automatica e Informatica Industrial. 13, 4, 393-402**

Abstract:
A fuzzy controller for a minimal states model is proposed to achieve a continuous and effcient insulin infusion in patients with Type 1 Diabetes. An Extended Kalman Filter is also applied to supply the deficiencies of the current glucose sensor technologies and estimate residual insulin in the system to predict future behavior. The controller is tuned manually and iteratively, and achieves closed-loop responses of glycemia constrained between [80,140] (View the MathML source), with a mean of 117, 6 (View the MathML source) and a standard deviation of 11, 3 (View the MathML source) over a whole year ensemble of 24-hour system responses with 4 meal intakes per day. These results show that is possible to design low complexity controllers that are easily tunable by experienced users or physicians focusing on a closed-loop system response analysis. Also, the combination of heuristic and model-based techniques allows to synthesize robust controllers for real application situations and, furthermore, effciently manage the insulin usage. Nevertheless, the actual application of a closed-loop system on a human

being should require higher dimension models to fit different situations, a proven robust controller and wide adaptability to different patients and their meal intake routine.

**Gutiérrez-Jarpa G., Laporte G., Marianov V., Moccia L., (2016) Multi-objective rapid transit network design with modal competition: The case of Concepción, Chile. Computers & Operations Research. 78, 27-43.**

Abstract:
We present a mixed integer linear program for the rapid transit network design problem with static modal competition. Previous discrete formulations cannot handle modal competition for realistic size instances because of the complexity of modeling alternatives for each flow in the network. We overcome this difficulty by exploiting a pre-assigned topological configuration. We discuss relevant goals of rapid transit planning, and we propose a multi-objective model conducive to a post-optimization analysis for effectiveness, efficiency, and equity concerns. A case study carried out for a metro proposal in Concepción, Chile, shows the suitability of the proposed method consisting of the mixed integer linear program coupled with the post-optimization analysis.

**Henríquez F., Jerez C., Altermatt F., (2016) Boundary integral formulation and semi-implicit scheme coupling for modeling cells under electrical stimulation. Numerische Mathematik. August, 1-45.**

Abstract:
We model the electrical activity of biological cells under external stimuli via a novel boundary integral (BI) formulation together with a suitable time-space numerical discretization scheme. Ionic channels follow a non-linear dynamic behavior commonly described by systems of ordinary differential equations dependent on the electric potential jump across the membrane. Since potentials in both intra– and extracellular domains satisfy an electrostatic approximation, we represent them using solely Dirichlet and Neumann traces over the membrane via boundary potentials. Hence, the volume problem is condensed to one posed over the cell boundary. A second-order time-stepping semi-implicit numerical Galerkin scheme is proposed and analyzed wherein BI operators are approximated by low-order basis functions, with stability independent of space discretization.

**Inzunza A., Moreno R., Bernales A., Rudnick H., (2016) CVaR constrained planning of renewable generation with consideration of system inertial response. Reserve Services and Demand Participation Energy Economics. 59, 104-177.**

Abstract:
Integration of renewable generation can lead to both diversification of energy sources (which can improve the overall economic performance of the power sector) and cost increase due to the need for further resources to provide flexibility and thus secure operation from unpredictable, variable and asynchronous generation. In this context, we propose a cost-risk model that can properly plan generation and determine efficient technology portfolios through balancing the benefits of energy source diversification and cost of security of supply through the provision of various generation frequency control and demand side services, including

preservation of system inertia levels. We do so through a scenario-based cost minimization framework where the conditional value at risk (CVaR), associated with costs under extreme scenarios of fossil fuel prices combined with hydrological inflows, is constrained. The model can tackle problems with large data sets (e.g. 8760 hours and 1000 scenarios) since we use linear programming and propose a Benders-based method adapted to deal with CVaR constraints in the master problem. Through several analyses, including the Chilean main electricity system, we demonstrate the effects of renewables on hedging both fossil fuel and hydrological risks; effects of security of supply on costs, risks and renewable investment; and the importance of demand side services in limiting risk exposure of generation portfolios through encouraging risk mitigating renewable generation investment.

**Jerez C., Schwab C. (2016) Electromagnetic wave scattering by random surfaces: uncertainty quantification via sparse tensor boundary elements. IMA Journal of Numerical Analysis.**

Abstract:
For time-harmonic scattering of electromagnetic waves from obstacles with uncertain geometry, we perform a domain perturbation analysis. Assuming as known both the scatterers' nominal geometry and its small-amplitude random perturbations statistics, we derive a tensorized boundary integral equation which describes, to leading order, the second order statistics, i.e. the two-point correlation of the randomly scattered electromagnetic fields. Perfectly conducting as well as homogeneous dielectric scatterers with random boundary and interface, respectively, are considered. Deterministic tensor equations for second-order statistics of both, Cauchy data on the nominal domain of the scatterer as well as of the far-field pattern are derived, generalizing the work by Harbrecht, Schneider and Schwab (Numer. Math., 109(3):385–414, 2008) to electromagnetics and to interface problems, and being an instance of the general programme outlined by Chernov and Schwab (Math. Comp., 82(284):1859–1888, 2013). The tensorized boundary integral equations are formulated on the surface of the known nominal scatterer. Sparse tensor Galerkin discretizations of these BIEs are proposed and analyzed based on the stability results by Hiptmair, Jerez-Hanckes and Schwab (BIT, 53(4):925-939); we show that they allow, to leading order, consistent Galerkin approximations of the complete second order statistics of the random scattered electric field, with computational work equivalent to that for the Galerkin solution of the nominal problem up to logarithmic terms.

**Karelovic, P., Putz, E., Cipriano A. (2006) Dynamic hybrid modeling and simulation of grinding–flotation circuitsfor the development of control strategies. Mineral Engineering 93, pp.65-79.**

Abstract:
Process simulation is a very important tool for the design, development, analysis and optimization oftechnical processes in the mineral industry. The ability to simulate process behavior without the costof test runs can prevent the loss of man-hours and production, in addition to providing a platform forthe development of control tools and strategies. The usefulness of a simulator ultimately relies on howaccurately the underlying mathematical model represents real behavior. In mineral processing, due tovaried complexities such as strong non-linearities, variable coupling, time varying parameters, etc.; thedevelopment of accurate

process models becomes an increasingly difficult task.This paper describes the modeling and simulation of the main components of a concentrator plant, thegrinding and flotation circuits. A hybrid dynamic model was favored to better represent the differentmodes of operation and non-linearities exhibited by the plant. Industrial plant data was used to calibratethe models used in the simulator. Simulation tests show that the performance of the simulator is qual-itatively similar to that of a real plant, and it can be effectively used as a tool for the design and simulationof control solutions.

**Latorre-Núñez G., Lüer-Villagra A., Marianov V., Obreque C., Ramis F., Neriz L., (2016) Scheduling operating rooms with consideration of all resources, post anesthesia beds and emergency surgeries. Computers & Industrial Engineering. 97, 248-257.**

Abstract:
Surgery rooms are among the most expensive resources in hospitals and clinics. Their scheduling is difficult because, in addition to the surgical room itself, each surgery requires a particular combination of human resources, as well as different pieces of equipment and materials. Furthermore, after each surgery, a post-anesthesia bed is required for the patient to recover. Finally, in addition to planned surgeries, the scheduling must be made in such a way as to accommodate the emergency surgeries that may arrive during each day, which must be attended within a limited time. We address the surgery scheduling problem considering simultaneously, for the first time, the operating rooms, the post anesthesia recovery, the resources required by the surgery and the possible arrival of emergency surgeries. We propose an integer linear programming model that allows finding optimal solutions for small size instances, we transform it to use constraint programming, and develop a metaheuristic based on a genetic algorithm and a constructive heuristic, that solves larger size instances. Finally, we present numerical experiments.

**Letelier K., Urbina J., Andía M., Tejos C., Irarrázaval P., Prieto C., Uribe S. (2016) Accelerating dual cardiac phase images using undersampled radial phase encoding trajectories. Magnetic Resonance Imaging. 34, 7, September, Pp. 1017–1025.**

Abstract:
A three-dimensional dual-cardiac-phase (3D-DCP) scan has been proposed to acquire two data sets of the whole heart and great vessels during the end-diastolic and end-systolic cardiac phases in a single free-breathing scan. This method has shown accurate assessment of cardiac anatomy and function but is limited by long acquisition times. This work proposes to accelerate the acquisition and reconstruction of 3D-DCP scans by exploiting redundant information of the outer k-space regions of both cardiac phases. This is achieved using a modified radial-phase-encoding trajectory and gridding reconstruction with uniform coil combination. The end-diastolic acquisition trajectory was angularly shifted with respect to the end-systolic phase. Initially, a fully-sampled 3D-DCP scan was acquired to determine the optimal percentage of the outerk-space data that can be combined between cardiac phases. Thereafter, prospectively undersampled data were reconstructed based on this percentage. As gold standard images, the undersampled data were also reconstructed using iterative SENSE. To validate the method, image quality assessments and a cardiac volume analysis were performed. The proposed method was tested in thirteen healthy volunteers (mean age, 30 years). Prospectively undersampled data (R = 4) reconstructed with 50% combination led high quality images. There

were no significant differences in the image quality and in the cardiac volume analysis between our method and iterative SENSE. In addition, the proposed approach reduced the reconstruction time from 40 min to 1 min. In conclusion, the proposed method obtains 3D-DCP scans with an image quality comparable to those reconstructed with iterative SENSE, and within a clinically acceptable reconstruction time.

**Lorca A., Çelik M., Ergun O., Keskinocak P., (2016) An Optimization-based decision-support tool for post-disaster debris operations. Production and Operations Management. October 2016.**

Abstract:
Debris generated by disasters can hinder relief efforts and result in devastating economic, environmental, and health problems. In this study, we present a decision-support tool employing analytical models to assist disaster and waste management officials with decisions regarding collection, transportation, reduction, recycling, and disposal of debris. The tool enables optimizing and balancing the financial and environmental costs, duration of the collection and disposal operations, landfill usage, and the amount of recycled materials. In addition to post-disaster operational decisions, the tool can also support the challenging task of developing strategic plans for disaster preparedness. We illustrate the applicability and effectiveness of the tool with a disaster scenario based on Hurricane Andrew.

**Marianov V., Eiselt H.A., (2016). On agglomeration in competitive location models. Annals of Operations Research. 246, 1, 31-55.**

**Abstract:**
Agglomeration of facilities that compete with each other is common in practice, which suggests the existence of forces driving facilities to locate in clusters. Shopping centers and food courts are everyday examples. Although these agglomeration forces have been adequately analyzed and explained in the economic literature, operational research location models have not taken them into consideration as of today. This is particularly troublesome, as locations prescribed by these models are rather dispersed, which is in blatant disagreement with the examples that can be observed in real life. We present a selective review of the economic literature dealing with agglomeration forces acting in a linear market, classifying these forces into weak and strong. This paper demonstrates the sensitivity of competitive location models with respect to some assumptions that cause agglomeration or dispersion.

**Molina J.D., Contreras J., Rudnick H. (2016) A risk-constrained project portfolio in centralized transmission expansion planning. IEEE Systems Journal. no.99, pp.1-9.**

Abstract:
The implementation of a centralized transmission expansion plan is a complex task when several investors compete and bid to build a new transmission asset, as is the case now in Chile. The assessment of a transmission project depends on the number of competitors, where the project is subject to risks, such as delays, penalties, and cost overruns. The risk faced by an investor is measured using the Conditional Value at Risk (CVaR), which can be interpreted as the risk of not reaching an expected return on investment, depending on the tolerance to risk

and the real income obtained with the investor's portfolio. This risk comes from the difference between the regulated income (investor's bid) and the real cost during the implementation and operation of the transmission project. The difference is the “surplus” profit that the investor obtains by participating in the tender, considering their risk tolerance. The goal is to determine the optimal value of a risky investor's portfolio made up of several transmission projects. The optimal portfolio may allow the central planner to improve the efficiency of the project allocation process. To test the methodology, two case studies are analyzed: the IEEE 24-bus Reliability Test System and a predefined expansion plan of Chile's Central Interconnected System (SIC)

**Mura J., Pino A. M., Sotelo J., Valverde I., Tejos C. , Andia M. E., Irarrázaval P., Uribe S. (2016) Enhancing the velocity data from 4D flow MR images by reducing its divergence. IEEE Transaction on Medical Imaging. 2016 May 18. [Epub ahead of print] DOI: 10.1109/TMI.2016.2570010.**

Abstract:
Velocity measurements from 4D flow MRI are prone to be affected by several imperfections of the MR system. Assuming that blood is incompressible, we propose a novel method for enhancing the velocity field by reducing its divergence. To enhance the velocity data, we added a corrector velocity to each voxel such that the divergence is minimized. The method was validated using an analytical Womersley flow model for different settings of resolution and noise levels. The performance of the proposed method was also assessed in volunteers and patients. Results demonstrated a significant reduction of the divergence depending on the size of the regularization term, obtaining a reduction close to 50% of the mean divergence with negligible modification of flow parameters. Remarkably, we found that the reduction of the divergence, in percentage, was independent of volunteers, resolution or noise.

**Naranjo W.; Munoz L.; Pereda J.; Cortes C., "Design of Electric Buses for Rapid Transit using Hybrid Energy Storage and Local Traffic Parameters," in IEEE Transactions on Vehicular Technology , vol.PP, no.99, pp.1-1. doi: 10.1109/TVT.2016.2616401.**

Abstract:
In this paper, an electric powertrain for a Bus of Rapid Transit (BRT) is designed, including the driving behavior, road infrastructure, orography, and traffic system as a fundamental part of the design. An electric hybrid power source is proposed to efficiently recover the braking energy and for fast charging at bus stations. Since the local traffic parameters have direct influence over the BRT energy consumption, an energy methodology to obtain a characteristic and energy representative synthetic driving cycle is proposed and then experimentally tested in a real BRT system. The BRT system of Bogota - Colombia, Transmilenio, was chosen as a case study. This BRT system is selected due to its particular orography which increases the energy consumption. Additionally, a BRT dynamic model is proposed to analyze the energy requirements prior to designing the electric powertrain and the two energy storage systems. As a result, and main contribution, an innovative general methodology to BRT powertrain design is established, using the BRT dynamic model and local traffic parameters.

**Nayyar A., Negrete-Pincetic M., Poolla K., Varaiya, P. (2016) Duration-differentiated energy services with a continuum of loads. IEEE Transactions on Control of Network Systems. 3, 2, 182-191.**

Abstract:
As the proportion of total power supplied by renewable sources increases, it gets more costly to use reserve generation to compensate for the variability of renewables, such as solar and wind. Hence, attention has been drawn to exploiting flexibility in demand as a substitute for reserve generation. Flexibility has different attributes. In this paper, we consider loads requiring a constant power for a specified duration (within say one day), whose flexibility resides in the fact that power may be delivered at any time so long as the total duration of service is equal to the load's specified duration. We give conditions under which a variable power supply is adequate to meet these flexible loads, and describe how to allocate the power to the loads. We also characterize the additional power needed when the supply is inadequate. We study the problem of allocating the available power to loads to maximize welfare, and show that the welfare optimum can be sustained as a competitive equilibrium in a forward market in which electricity is sold as service contracts differentiated by the duration of service and power level.

**Negrete M., de Castro L., Pulgar H.A., (2016) Electricity supply auctions: understanding the consequences of the product definition. International Journal of Electrical Power & Energy Systems. 64, 285-292.**

Abstract:
We study the impact of product definition in electricity auctions. Recognizing the key role of the auction rules—pay as bid, uniform—the definition of the product itself emerges also as a critical step. Poorly designed products may impact both the market performance and the physical operation of the system. We investigate the impacts that the product definition can have on the market outcomes. A product definition implemented in some electricity markets is used to unveil critical aspects that must be considered when electricity products are defined. Our results provide guidelines for improving the product definition in electricity auctions.

**Negrete M., Nayyar A., Poolla, k., Salah, F., Varaiya, P. (2016) Rate-constrained energy services in electricity. IEEE Transactions on Smart Grid. publicada el 2016/10/31, 1-15.**

Abstract:
The integration of renewable generation poses operational and economic challenges for the grid. For the problem of power balance, the legacy paradigm of tailoring supply to follow demand may be inappropriate under deep penetration of renewable generation. In this situation, the alternative approach of controlling demand to follow supply offers compelling benefits in terms of reduced regulation costs. This paper considers rate-constrained energy services(RCES) which are a specific paradigm for flexible demand. These services are characterized by a delivery window, the total amount of energy that must be supplied, and the maximum rate at which this energy maybe delivered. We consider a forward market where RCES are traded. We explore allocation policies and market decisions of a supplier in this market. The supplier owns a generation mix that includes some uncertain renewable generation and may also purchase energy in day-ahead and real-time markets to meet customer demand. The supplier must optimally select the portfolio of RCES to sell, the amount of day-ahead energy to buy, and the policies for making real-

time energy purchases and allocations to customers to maximize its expected profit. We offer solutions to the supplier's decision and control problems to economically provide RCES. We provide numerical results illustrating our finds.

**Núñez, F., Wang, Y., Teel, A. R., Doyle III, Francis J. (2016) Synchronization of pulse-coupled oscillators to a global pacemaker. Systems & Control Letters. Volume 88, February 2016, Pages 75-80.**

Abstract:
Pulse-coupled oscillators (PCOs) are limit cycle oscillators coupled by exchanging pulses at discrete time instants. Their importance in biology and engineering has motivated numerous studies aiming to understand the basic synchronization properties of a network of PCOs. In this work, we study synchronization of PCOs subject to a global pacemaker (or global cue) and local interactions between slave oscillators. We characterize solutions and give synchronization conditions using the phase response curve (PRC) as the design element, which is restricted to be of the delay type in the first half of the cycle, interval $(0,\pi)$, and of the advance type in the second half of the cycle, interval $(\pi,2\pi)$. It is shown that global synchronization is feasible when using an advance-delay PRC if the influence of the global cue is strong enough. Numerical examples are provided to illustrate the analytical findings.

**Oses N., Watts D., Pérez R. (2016) Assessment of wind energy potential in Chile: A project-based regional wind supply function approach. Renewable Energy. 96, 738-755.**

Abstract:
Wind energy is now one of the fastest growing renewable energy sources in Chile, making it the second largest market for wind power in Latin America. This paper describes the evolution and the current state of wind power in Chile, presenting the location and performance of all wind farms in Chile. This article also aims to identify the locations of the most cost-effective wind energy potential to be developed in the near future, thus applying a project-based approach. This requires studying each individual wind farm under development or environmental evaluation. This means modeling 70 wind farm projects over the country summing 8510 MW. For each project hourly wind production profiles and histograms are developed, allowing the assessment of variability and spatial and temporal complementarity. The production of neighboring projects injecting their energy in the same transmission bus is aggregated, generating wind production profiles and histograms at transmission level. The Levelized Cost of Electricity of each project is used as a measure of economic feasibility and serves as input to produce wind supply functions for each region. This allows us to identify the most cost-effective wind energy zones for medium-term project development, a valuable input for transmission planners and the regulator.

**Paredes G., Marianov V., Bronfman A., Obreque C., Lüer A., (2016) A milk collection problem with blending. Transportation Research Part E-Logistics and Transportation Review. 24, 26-43.**

Abstract:

A milk collection problem with blending is introduced. A firm collects milk from farms, and each farm produces one out of three possible qualities of milk. The revenue increases with quality, and there is a minimum requirement at the plant for each quality. Different qualities of milk can be blended in the trucks, reducing revenues, but also transportation costs, resulting in higher profit. A mixed integer-programming model, a new cut, and a branch-and-cut algorithm are proposed to solve medium-sized instances. A three-stage heuristic is designed for large instances. Computational experience for test instances and a large-sized real case is presented.

**Pereda, J.; Green, T. C. (2016) Direct Modular Multilevel Converter With Six Branches for Flexible Distribution Networks. IEEE Transactions on Power Delivery. 31, 4, pp. 1728-1737.**

Abstract:
This paper presents a complete analysis of a directac-to-ac modular multilevel converter (direct MMC) applied inmedium-voltage distribution networks through the soft-open-pointconcept. The direct MMC is capable of bidirectional power flowbetween two feeders at any power factor, even when the feedershave different nominal voltages and operate with a phase-shift an-gle or unbalanced voltages. The converter has six branches, eachone composed of full H-bridges cells connected in series to generatea multilevel voltage waveform, to share the blocking voltage of thepower switches and to have fault-tolerant operation. This paperpresents a suitable control scheme and provides a discussion aboutthe capabilities and limitations of the converter, the capacitor volt-age balance control, the efficiency, and the power-loss mitigation atvarious operation points. Simulation results and power-loss calcu-lations are presented for a three-phase 11-kV 16-MVA direct MMCwith 10 H-bridge cells per branch. The direct MMC is simulatedin a distribution network to demonstrate the features of the con-verter and control under various operation conditions, includinggrid faults.

**Pérez J., Maldonado S., Marianov V. (2016) A reconfiguration of fire station and fleet locations for the Santiago Fire Department. International Journal of Production Research. 54, 11, 3170-3186.**

Abstract:
The geographical distribution of the population of the city of Santiago, Chile, has changed significantly in recent years. In spite of this fact, the location of the fire stations has remained unchanged. We propose a model for the optimal location of the fire stations and a fleet assignment for the Santiago Fire Department (SFD), aimed at maximizing the number of events attended to with a predefined standard response. The results of the model are compared with respect to the current location of fire stations and fleet assignment in the SFD. There are different types of resources (stations and vehicles), and different types of events in which the same types of vehicles are used. We analyze various possible current and future scenarios, using a forecast based on historical data. Our results show that by optimally reallocating the resources a 10 to 30% increase can be achieved in the number of emergency calls that are attended to with an adequate response in time and number of vehicles, without the need for additional fire stations or vehicles. Thus our contribution is empirical and relies on the real world application which is being considered by Chilean government.

**Ríos M. (2016) GeOpps-N: Opportunistic routing for VANET in a public transit system. IEEE Latin America Transactions. 14, 4, 1630-1638.**

Abstract:
GeOpps-N, a new hybrid routing protocol for communications between buses and operation control centers in a Public Transportation System (PTS) is proposed. Bus location must be updated each 30 seconds. We model the system as a Vehicular Ad-Hoc Network (VANET), which includes buses and Road Side Units (RSU). The network has a low density and is usually clustered, thus requiring relaying of the data. Topology-based routing protocols have proven to be well suited for these low node density scenarios, as compared with other protocols such as geographic-based routing or flooding-based routing. In these protocols, instead of looking for the destination inside the source cluster, the best candidate to transport the message to its destination is found. GeOpps-N searches for relaying nodes which can efficiently transport or relay the data to the closest RSU. GeOpps-N brings together aspects from reactive network topology-based routing and geographic-based routing protocols for delay tolerant networks. In our simulations, it improves the packet delivery ratio by up to 159% over the results of reactive protocols, such as DYMO-UM and DYMO-FAU and up to 59% over GeOpps. GeOpps-N also improves the mean end-to-end delay by up to 36% as compared to GeOpps.

**Rosas F., Demo Souza R., Pellenz M.E., Oberli C., Brante G., Verhelst M., Pollin S. (2016) Optimizing the code rate of energy-constrained wireless communications with HARQ. IEEE Transactions on Wireless Communications. 15, 1, 191-205.**

Abstract:
Retransmissions due to decoding errors have a big impact on the energy budget of low-power wireless communication devices, which can be reduced by using hybrid automatic repeat request (HARQ) techniques. Nevertheless, this reduction comes at the cost of extra energy consumption introduced by the added computational load. No complete analysis of the tradeoff between retransmissions reduction and baseband consumption of low-power communications over fading channels has been reported so far. In this paper, we study the energy efficiency achievable by HARQ schemes when the code rate of the error-correcting code is optimized. For this purpose, we develop an energy consumption model that focuses on simple HARQ (S-HARQ) and Chase combining (HARQ-CC) transmissions, which are studied under fast-fading and block-fading scenarios with Nakagami- m fading. The retransmission statistics are analyzed, and expressions for the expected number of transmission trials are derived. Using this framework, it is shown that transmission schemes with high diversity gain are the most efficient choice for long range transmissions, which in our case correspond to HARQ-CC and codes with low code rate. On the other hand, schemes with good multiplexing capabilities are optimal for short link distances, which in our analysis correspond to S-HARQ and high code rates. It is also shown that HARQ-CC can effectively extend the transmission range of a low-power communication device.

**Sepúlveda P., Sitaram R., Rana M., Montalba C., Tejos C. Ruiz S. ( 2016 ) How feedback, motor imagery, and reward influence brain self-regulation using real-time fMRI. Human Brain Mapping. 37, 9, 3153-3171.**

Abstract**:**

The learning process involved in achieving brain self-regulation is presumed to be related to several factors, such as type of feedback, reward, mental imagery, duration of training, among others. Explicitly instructing participants to use mental imagery and monetary reward are common practices in real-time fMRI (rtfMRI) neurofeedback (NF), under the assumption that they will enhance and accelerate the learning process. However, it is still not clear what the optimal strategy is for improving volitional control. We investigated the differential effect of feedback, explicit instructions and monetary reward while training healthy individuals to up-regulate the blood-oxygen-level dependent (BOLD) signal in the supplementary motor area (SMA). Four groups were trained in a two-day rtfMRI-NF protocol: GF with NF only, GF,I with NF + explicit instructions (motor imagery), GF,R with NF + monetary reward, and GF,I,R with NF + explicit instructions (motor imagery) + monetary reward. Our results showed that GF increased significantly their BOLD self-regulation from day-1 to day-2 and GF,R showed the highest BOLD signal amplitude in SMA during the training. The two groups who were instructed to use motor imagery did not show a significant learning effect over the 2 days. The additional factors, namely motor imagery and reward, tended to increase the intersubject variability in the SMA during the course of training. Whole brain univariate and functional connectivity analyses showed common as well as distinct patterns in the four groups, representing the varied influences of feedback, reward, and instructions on the brain.

**Sotelo J., Urbina J., Valverde I., Tejos C., Irarrázaval P., Andia M., Uribe S., Hurtado D. (2016). 3D quantification of wall shear stress and oscillatory shear index using a finite-element method in 3D CINE PC-MRI data of the thoracic aorta. IEEE Transactions on Medical Imaging, accepted 2016. DOI: 10.1109/TMI.2016.2517406.**

Abstract:

Several 2D methods have been proposed to estimate WSS and OSI from PC-MRI, neglecting the longitudinal velocity gradients that typically arise in cardiovascular flow, particularly on vessel geometries whose cross section and centerline orientation strongly vary in the axial direction. Thus, the contribution of longitudinal velocity gradients remains understudied. In this work, we propose a 3D finite-element method for the quantification of WSS and OSI from 3D-CINE PC-MRI that accounts for both in-plane and longitudinal velocity gradients. We demonstrate the convergence and robustness of the method on cylindrical geometries using a synthetic phantom based on the Poiseuille flow equation. We also show that, in the presence of noise, the method is both stable and accurate. Using computational fluid dynamics simulations, we show that the proposed 3D method results in more accurate WSS estimates than those obtained from a 2D analysis not considering out-of-plane velocity gradients. Further, we conclude that for irregular geometries the accurate prediction of WSS requires the consideration of longitudinal gradients in the velocity field. Additionally, we compute 3D maps of WSS and OSI for 3D-CINE PC-MRI data sets from an aortic phantom and sixteen healthy volunteers and two patients. The OSI values show a greater dispersion than WSS, which is strongly dependent on the PC-MRI resolution. We envision that the proposed 3D method will improve the estimation of WSS and OSI from 3D-CINE PC-MRI images, allowing for more accurate estimates in vessels with pathologies that induce high longitudinal velocity gradients, such as coarctations and aneurisms.

**Urbina J., Sotelo J., Tejos C., Irarrázaval P., Andia M. E., Razavi R., Valverde I., Uribe S. (2016) A realistic aortic phantom to study hemodynamics using MRI and cardiac catheterization in normal and aortic coarctation conditions. Journal Magnetic Resonanse Imaging. 2016 [Epub ahead of print]. DOI:10.1002/jmri.25208.**

Abstract:
PURPOSE:
To design and characterize a magnetic resonance imaging (MRI)-compatible aortic phantom simulating normal and aortic coarctation (AoCo) conditions and to compare its hemodynamics with healthy volunteers and AoCo patients.
MATERIALS AND METHODS:
The phantom is composed of an MRI-compatible pump, control unit, aortic model, compliance chamber, nonreturn, and shutoff valves. The phantom without and with AoCo (13, 11, and 9 mm) was studied using 2D and 3D phase-contrast data and with a catheterization unit to measure pressures. The phantom data were compared with the mean values of 10 healthy volunteers and two AoCo patients.
RESULTS:
Hemodynamic parameters in the normal phantom and healthy volunteers were: heart rate: 68/61 bpm, cardiac output: 3.5/4.5 L/min, peak flow and peak velocity (Vpeak) in the ascending aorta (AAo): 270/357 mL/s (significantly, $P < 0.05$) and 97/107 cm/s (not significantly, $P = 0.16$), and pressure in the AAo of the normal phantom of 131/58 mmHg. Hemodynamic parameters in the 13, 11, and 9 mm coarctation phantoms and Patients 1 and 2 were: heart rate: 75/75/75/97/78 bpm, cardiac output: 3.3/3.0/2.9/4.0/5.8 L/min, peak flow in the AAo: 245/265/215/244/376 mL/s, Vpeak in the AAo: 96/95/81/196/187 cm/s, Vpeak after the AoCo: 123/187/282/247/165 cm/s, pressure in the AAo: 124/56, 127/51, 133/50, 120/51 and 87/39 mmHg, and a trans-coarctation systolic pressure gradient: 7, 10, 30, 20, and 11 mmHg.
CONCLUSION:
We propose and characterize a normal and an AoCo phantom, whose hemodynamics, including velocity, flow, and pressure data are within the range of healthy volunteers and patients with AoCo.

**Velásquez C., Watts D. Rudnick H. Bustos C. (2016) A Framework for Transmission Expansion Planning: A Complex Problem Clouded by Uncertainty. IEEE Power & Energy Magazine. 4, 20-29 14.**

Abstract**:**
Transmission Expansion Planning (TEP), a complex problem that is vital to ensure the proper functioning of restructured electricity markets, is clouded by uncertainties. Timely and cost-effective transmission expansion is necessary for providing secure and reliable electricity service to customers, enhancing competition, and ensuring market efficiency in electricity markets. Given the irreversibility and long lifetimes of transmission investments, TEP requires addressing uncertainties on future system conditions several years ahead. Because of these fundamental properties of transmission, the importance of developing tools and models to assist power system planning under uncertainty has long been recognized. As any decision under uncertainty is made before the uncertainty is revealed, addressing uncertainties allows hedging against risks caused by the outcomes of decisions taken under uncertainty.

**Vourkas I., Papandroulidakis G., Sirakoulis G., Abusleme A., (2016) 2T1M-based double memristive crossbar architecture for in-memory computing. International Journal of Unconventional Computing. 12, 4, 265-280.**

Abstract**:**
The recent discovery of the memristor has renewed the interest for fast arithmetic operations via high-radix numeric systems. In this direction, a conceptual solution for high-radix memristive arithmetic logic units (ALUs) was recently published. The latter combines CMOS circuitry for data processing and a reconfigurable “segmented” crossbar memory block. In this paper we build upon such a conceptual design and propose a 3D extension of the classic crossbar topology via 2T1M cross-points which still permits the parallel creation of partial products for faster multiplication with lower circuit complexity. Furthermore, we present a binary to high-radix data conversion circuit to complement the state-programming module of the previous work. A simulation-based validation of read/write multi-level memory operations from/to the 2T1M 3D memristive crossbar was performed using SPICE and a threshold-type switching model of a bipolar voltage-controlled memristor. Such realization of in-memory computations could lead to faster arithmetic algorithms in future memristive ALUs.

## V. PUBLICACIONES EN CONGRESOS

**Aldunate, J. S. Pereda, J. (2016) "Hybrid control of cascaded h-bridge multilevel converters for multiple capacitor voltage balancing," 2016 IEEE International Conference on Industrial Technology (ICIT), Taipei, 2016, pp. 311-316. doi: 10.1109/ICIT.2016.7474770.**

Abstract:
Cascaded h-bridge multilevel converters presentmany benefits such as high modularity, level optimization and lowcommon-mode voltage, but require one independent bidirectionalvoltage source per h-bridge, increasing cost and reducing relia-bility. This paper presents a three stage asymmetric multilevelconverter using independent power sources in the main h-bridge and floating capacitors in the two auxiliar h-bridges. Ahybrid control method is proposed to balance multiple capacitors,combining a fundamental-voltage-control through modulationindex and a model predictive control. Simulation results showthe feasibility of the proposed hybrid control in steady-state anddynamic operation.

**Berdja Amokrane, Guzmán Christian Dani. (2016). Experimental results on using artificial neural networks for accurate centroiding in Shack-Hartmann wavefront sensors with elongated spots. SPIE. Astronomical Telescopes + Instrumentation. Edinburgh, Scotland, United Kingdom, 26 June–1 July.**

Abstract:
We introduced the use of Artificial Neural Networks (ANN) for centroiding in Shack–Hartmann wavefront sensors in the presence of elongated spots, as it will occur in Extremely Large Telescopes. We showed in simulation that ANNs can outperform existing techniques, such as the Matched Filter. The main advantage of our technique is its ability to cope with changing conditions, as real atmospheric turbulence behaves. Here we present experimental results from the laboratory that confirm the findings in our original article, while at the same time they are useful to refine the ANN-based techniques.

**Drass Holger; Vanzi Leonardo; Torres-Torriti Miguel; Dünner Rolando; Shen Tzu-Chiang; Belmar Francisco; Dauvin Lousie; Staig Tomás; Antognini Jonathan; Flores Mauricio; Luco Yerko; Béchet Clémentine; Boettger David; Beard Steven; Montgomery David; Watson Stephen; Cabral Alexandre; Hayati Mahmoud; Abreu Manuel; Rees Phil; Cirasuolo Michele; Taylor William; Fairley Alasdair (2016) Implementation and performance of the metrology system for the multi-object optical and near-infrared spectrograph MOONS. Conference Volume 9908 Ground-based and Airborne Instrumentation for Astronomy VI Christopher J. Evans; Luc Simard; Hideki Takami Edinburgh, United Kingdom | June 26, 2016.**

Abstract:

The Multi-Object Optical and Near-infrared Spectrograph (MOONS) will cover the Very Large Telescope's (VLT) field of view with 1000 fibres. The fibres will be mounted on fibre positioning units (FPU) implemented as two-DOF robot arms to ensure a homogeneous coverage of the 500 square arcmin field of view. To accurately and fast determine the position of the 1000 fibres a metrology system has been designed. This paper presents the hardware and software design and performance of the metrology system. The metrology system is based on the analysis of images taken by a circular array of 12 cameras located close to the VLTs derotator ring around the Nasmyth focus. The system includes 24 individually adjustable lamps. The fibre positions are measured through dedicated metrology targets mounted on top of the FPUs and fiducial markers connected to the FPU support plate which are imaged at the same time. A flexible pipeline based on VLT standards is used to process the images. The position accuracy was determined to ~5 μm in the central region of the images. Including the outer regions the overall positioning accuracy is ~25 μm. The MOONS metrology system is fully set up with a working prototype. The results in parts of the images are already excellent. By using upcoming hardware and improving the calibration it is expected to fulfil the accuracy requirement over the complete field of view for all metrology cameras. 

**Eiselt H.A., Lüer-Villagra Armin, Marianov Vladimir (2016). p-hub location problems with economies of scale. 28th European Conference on Operational Research, Poland.**
Abstract:
This presentation considers p-hub problems with the usual assumptionthat inter-hub trac receives significant discounts. These discountsare based on the notion that inter-hub trac is typically much heavierthan trac between spokes and hubs, so that economies of scaleapply. However, it may very well turn out that trac in an inter-hubconnection is actually quite low, i.e., below a given threshold, so thata discount is not justified. Similarly, trac in hub-to-spoke connectionsmay be suciently high so as to justify a discount where none isgiven in the mathematical model. If a solution to such a "fundamentalmodel" were to be applied, we would have to cancel discounts ofcome arcs as the flow does not justify their use. This results in nonoptimalsolutions. We formulate a mathematical model that locates phubs, while awarding discounts in all direct connections, in which thetrac flow equals or exceeds a given threshold. Some standard problemset is solved, and the results are evaluated by way of some set ofperformance indicators, including the average route length, the averagenumber of legs of a route, and the fraction of discounted arcs. Computingtimes range from a little more than a minute to about seven hours. The results show significant improvements with our model.

**Garcés Santibañez Eduardo, Guzmán Christian Dani, Jones Damien, Angeloni Rodolfo (2016). Update on BOMBOLO: a 3-arm, wide-field, near-UV/optical imager for the 4-meter SOAR telescope. SPIE. Astronomical Telescopes * Instrumentation. Edinburgh, Scotland, United Kingdom, 26 June–1 July.**
Abstract:
BOMBOLO is a wide field imager, capable of simultaneous, synchronous and independent observations in three different bands for covering a series of scientific cases, in the not-so-explored time window of tens of seconds to minutes exposures, to be installed at SOAR

observatory. Given its length, weight and mounting limitations, we discuss the current mechanical and opto-mechanical design of the instrument, given flexures caused by a changing gravity vector. In order to validate our designs, a Monte-Carlo simulation is used to explore different observing conditions, as the starting point for static and dynamic studies of the structure using FEA tools.

**González-Núñez Héctor , Béchet Clémentine, Guesalaga Andrés (2016). Laser beam shaping simulations for generation of artificial stars constellations. SPIE. Astronomical Telescopes + Instrumentation. Edinburgh, Scotland, United Kingdom, 26 June–1 July.**

Abstract:
The potential benefit of a beam shaping system applied to laser-based astronomical adaptive optics has been recently proposed. We report the study of different methods to generate laser guidestar (LGS) asterisms by using continuous face-sheet deformable mirrors (DMs). We perform detailed numerical simulations with novel beam shaping algorithms applied to the generation of astronomical LGS asterisms. The possibility of using multiple DMs to accomplish this task and the differences between near-field and far-field beam shaping algorithms are presented. Parameters like the diameter of the launch telescope, the number of actuators of the DMs and their influence function are also evaluated.

**Guesalaga Andrés, Neichel Benoit , Correia Carlos M., Butterley Timothy, Osborn James, E. Masciadri, T. Fusco, J-F. Sauvage (2016). Online estimation of atmospheric turbulence parameters and outer-scale profiling. SPIE. Astronomical Telescopes + Instrumentation. Edinburgh, Scotland, United Kingdom, 26 June–1 July.**

Abstract:
An online technique for a complete estimation of the atmospheric turbulence parameter is presented. An outer scale profiler - L0(h)- is central to the method, as the other parameters (Cn2(h), r0, θ0 and τ0) are strongly affected by its distribution. The method is applied to the Gemini South MCAO system (GeMS). Statistical values of turbulence parameters at Cerro Pachón from reduced data acquired with GeMS along three years are shown. Especially interesting are the results for L0(h), where some interesting resemblance to other independent results in the literature are shown.

**Guesalaga Andrés, Osborn James, Sarazin Marc S., Neichel, Benoit, Saavidra Perera Richard (2016). FASS: the full aperture seeing sensor. SPIE. Astronomical Telescopes + Instrumentation. Edinburgh, Scotland, United Kingdom, 26 June–1 July.**

Abstract:
We describe a novel turbulence profiler: FASS (full aperture seeing sensor). It uses the full aperture of the telescope, a low noise CCD detector and Fourier processing. Excellent performance is achieved using on-sky and simulated data from small and 1m class telescopes. The profiles are compared to those simultaneously obtained with the Durham Stereo-SCIDAR instrument. Although the technique is expected to operate in the generalized mode, the size of the CCD pixels is crucial and can severely limit the accuracy at low altitudes, especially for

small negative conjugation altitudes. Finally, the resilience of the method to strong turbulence regimes (s2 > 0.4) is addressed.

**Guesalaga, S. Perera, J. Osborn, M. Sarazin, B. Neichel, R. Wilson (2016). FASS: the full aperture seeing sensor. SPIE. Astronomical Telescopes + Instrumentation. Edinburgh, Scotland, United Kingdom, 26 June–1 July.**

Abstract:

We describe a novel turbulence profiler: FASS (full aperture seeing sensor). It uses the full aperture of the telescope, a low noise CCD detector and Fourier processing. Excellent performance is achieved using on-sky and simulated data from small and 1m class telescopes. The profiles are compared to those simultaneously obtained with the Durham Stereo-SCIDAR instrument. Although the technique is expected to operate in the generalized mode, the size of the CCD pixels is crucial and can severely limit the accuracy at low altitudes, especially for small negative conjugation altitudes. Finally, the resilience of the method to strong turbulence regimes (s2 > 0.4) is addressed.

**Marianov Vladimir, Bronfman Andrés, Paredes-Belmar Germán , Armin Lüer-Villagra (2016) The maxisum and maximin-maxisum HAZMAT routing problems. 28th European Conference on Operational Research, Poland.**

Abstract:

We design routes for transportation of hazardous materials (HAZMAT) in urban areas, with multiple origin-destination pairs. First, we introduce the maxisum HAZMAT routing problem, which maximizes the sum of the population-weighted distances from vulnerable centers to their closest point on the routes. Secondly, the maximin-maxisum HAZMAT routing problem trades-o maxisum versus the population weighted distance from the route to its closest center. We propose e-cient IP formulations for both NP-Hard problems, as well as a polynomial heuristic that reaches gaps below 0.54% in a few seconds on the real case in the city of Santiago, Chile. real case in the city of Santiago, Chile.

**Marianov Vladimir, Lüer-Villagra Armin, Eiselt H.A. (2016). Economies of Scale in Hub Location. LAND TRANSLOG, Santa Cruz, Chile, March 13 – 17.**

Abstract:

Hub-and-spoke networks are the choice structure for most of passenger transportation, postal and parcel service industries, as they allow taking advantage of economies of scale. In this talk, we explain the reasons why this structure is used, its costs, and discuss its different variants, as well as what is called the fundamental model, the most extended model for the location of hubs. We also describe the different types of economies that can be present in these networks. Unfortunately, the fundamental model is a simplification of the problem, which assumes certain behavior of the traffic that frequently do not hold in the obtained solutions. Because of this, the fundamental model does not adequately represent the economies of scale. Addressing this shortcoming is an active line of current research, which we briefly describe. Finally, as examples, we describe two possible approaches we have followed to solve the shortcoming of

the fundamental model, consisting the first in designing the network starting from its basic components and the second, in using a simple flow-threshold based model. We concentrate in this last one, which builds a single allocation, incomplete inter-hub, p-hub location network in which the flow in an arc is discounted if it exceeds a fixed threshold. The results show that this model is able to represent the existence of economies of scale, requires a reasonable computational effort, tends to consolidate flows between hubs, and provides readily implementable solutions to the decision makers.

**Masciadri Elena, Neichel Benoit, Guesalaga Andrés, Turchi Alessio (2016). Towards an automatic system for monitoring of CN2 and wind speed profiles with GeMS. SPIE. Astronomical Telescopes + Instrumentation. Edinburgh, Scotland, United Kingdom, 26 June–1 July.**

Abstract:
In order to assess the reliability of the GeMS wind speed estimates we compare wind speed measurements from GeMS with those provided by the atmospherical model Meso_NH that has been previously proved to provide very accurate estimate of the wind speed stratification. A comprehensive statistical analysis done on a rich sample of nights will be provided with the goal to confirm the promising conclusions obtained in a preliminary study. Besides we investigate a solution for an automation of the GeMS wind speed and CN2 profiles estimates based on the injection of the Meso-Nh outputs in the GeMS software.

**Milovic Carlos, Pinto José Miguel, Acosta-Cabronero Julio, Irarrazaval Pablo, Tejos Cristián (2016) Parameter selection in Total Generalized Variation based reconstruction problems. 24th International Conference of the ISMRM, Singapur, May 2016 (Poster).**

Abstract:
TGV involves the selection of three parameters: α0, α1 and λ. Whereas α0 and α1 regulate an anisotropic diffusion process, λ weights a data fidelity term. The ratio α0/α1 is normally set between 0.5 and 2.01,2,3,4. Although α1 and λ are somehow linked, how they affect the quality of the reconstructions remains unclear. Additionally, there are some applications such as Quantitative Susceptibility Mapping (QSM) where traditional strategies to set reconstruction parameters (e.g. L-curve) may fail. We present a strategy for parameter selection in TGV-based reconstructions. Our method delivers quasi-optimal parameters with a relatively small number of sampled points

**Milovic Carlos Istvan Madai Vince, Huelnhagen Till, Niendorf Thoralf, Wuerfel Jens, Tejos Cristian, Pinto Jose Miguel , Acosta-Cabronero Julio, Dusek Petr (2016). Improved magnetic dipole kernel for reconstruction methods in Quantitative Susceptibility Mapping (QSM). 24th International Conference of the ISMRM, Singapur, May 2016 (e-Poster).**

Abstract:
We propose a new kernel-based QSM reconstruction method using the discrete cosine transform and discrete derivative operators. The method minimizes aliasing artifacts, avoids noise amplification and improves detection of small objects and tissue interfaces. This is

demonstrated numerically with a synthetic phantom and qualitatively with ultra-high resolution QSM of post-mortem brain tissue.

**Montalba Cristian, Urbina Jesús, Sotelo Julio, Andia Marcelo, Tejos Cristián, Irrarázaval Pablo, Valverde Israel, Uribe Sergio (2016). Variability of flow parameters when subjected to changes of MR acquisitions parameters in 4D flow MRI using a realistic thoracic aortic phantom. 24th International Conference of the ISMRM, Singapur, May 2016 (e-Poster).**

Abstract:

4D flow is a MRI technique characterized by long scanning times. Because of that, it is difficult to study the variability of flow parameters when subjected to changes of the MR parameters. The purpose of this work is to study the variability of different flow parameters due to changes of spatial and temporal resolutions in 4D flow acquisitions through controlled experiments using a realistic normal adult thoracic aortic phantom. We conclude that changing the spatial and temporal resolutions in the 4D flow imaging greatly affects different flow parameters with induced errors of up to 23.9%.

**Neichel Benoît, Guesalaga Andrés, Gendron Éric, Masciadri Elena, Morris Timothy J., Fusco Thierry, Vidal Fabrice, Sivo Gaetano, Osborn James, Garrel Vincent, Rousset Gérard, Rigaut Francois, Correia Carlos M., Butterley Timothy, Oberti Sylvain, Kolb Johann, Madec Pierre-Yves, Lardière Olivier, Conan Jean-Marc, Robert Clélia, Ziad Aziz, Martin Olivier, Ono Yoshito H. (2016) Review on AO real-time turbulence estimation. SPIE. Astronomical Telescopes + Instrumentation. Edinburgh, Scotland, United Kingdom, 26 June–1 July.**

Abstract**:**

In this talk, we will review the different methods and results developed for estimating turbulence parameters from Adaptive Optics (AO) real-time data. We will cover different systems, and compare the needs, and approaches developed in order to get the relevant information. Finally, we will tentatively extrapolate those results for the future Extremely Large Telescopes, and show how important it is to get an accurate profile estimation for the future Wide-Field AO systems planned for these giants.

**Pereira Jaime A., Sepulveda Pradyumna, Rana Mohit, Montalba Cristian, Torres Rafael, Tejos Cristián, Sitaram Ranganatha, Ruiz Sergio. (2016) Volitional control of Fusiform Face Area in Autism Spectrum Disorder with Brain Computer Interfaces. OHBM 2016 (Poster).**

Abstract:

Brain-Computer Interfaces (BCIs) are based on a circular re-entry system in which brain signals of participants are translated into artificial outputs (Shih et al. 2012). BCIs based on real-time functional Magnetic Resonance Imaging (fMRI-BCI) are novel techniques that allowed healthy individuals and patients to achieve self-regulation of circumscribed brain regions, leading to behavioral changes (Sitaram et al. 2007; Ruiz et al. 2013). These methodologies enables to establish causal relationships between hemodynamic activity and

behavior (Weiskopf 2012; Ruiz et al. 2014; Birbaumer et al. 2013) and opens new potential treatment possibilities (Daly & Wolpaw 2008). Despite a growing number of studies using fMRI-BCI, this methodology has not yet been reported in Autism Spectrum Disorder (ASD).
ASD is a chronic frequent neurodevelopmental disorder associated with high cost for both their relatives and the society (Lai et al. 2014). One of the most important impairments in ASD is the abnormal processing of human faces (i.e. facial emotion recognition and facial identity recognition) (Dawson et al. 2005), that seems to be associated with an abnormal activity of fusiform face area (FFA) (Nickl-Jockschat et al. 2014). Therefore, the modulation of this brain region could lead to positive behavioral modifications. The main aim of this preliminary study is to determine if young patients with ASD can achieve self-regulation of the activity of FFA with fMRI-BCI.

**Sepúlveda P., Sitaram R., Rana M., Montalba C., Tejos C., Ruiz S. Influence of feedback, motor imagery and reward in brain self-regulation using real-time fMRI. OHBM 2016.**
Abstract:
During the last decade, several studies have demonstrated the potential therapeutic and research applications of real time fMRI (rtfMRI) neurofeedback (NF) [1,2]. In fMRI NF studies, it is common to instruct experimental subjects with specific mental imagery to improve the process of selfregulation. However, it is yet to be defined which is the optimal modality to improve self-regulation capacity [3]. If learning how to self-regulate our brain metabolism is mainly determined by operant conditioning, then explicit and conscious strategies may not be necessary and reinforcement could be playing an important role in the modulation of brain activation [4]. In this scenario, strengthen reinforcements, like giving an extra monetary reward, would greatly influence a successful learning outcome in rtfMRI-NF training.

**Sitaram Ranganatha , Montalba Cristian, Rana Mohit, Tejos Cristián, Ruiz Sergio (2016). How feedback, verbal instruction and reward influence brain self-regulation? A real-time fMRI study. 24th International Conference of the ISMRM, Singapur, May 2016 (Poster).**
Abstract:
Explicity instructing subject to use mental imagery and giving monetary reward are two strategies used to complement contingent neurofeedback (NF) in the process of learning to self-regulate BOLD signal with real-time fMRI NF. However, it is yet to be defined which is the optimal protocol design in rtfMRI-NF studies, critical step for potential clinical applications. The present study compares the influence of these two strategies in NF learning. Results showed a positive effect of monetary reward in BOLD signal change. Mental imagery had no significant impact in rtfMRI learning. Despite variation os strategies, brain patterns during NF training were similar.

**Sotelo J., Uribe S., Hurtado D.. (2016) Tridimensional Quantification of Cardiovascular Hemodynamics Parameter Using Finite Element Methods From 4D Flow MRI Data. Fifth Chilean Workshop on Numerical Analysis of Partial Differential Equations, Universidad de Concepción, Concepción, Chile, January 11 - 15. (Oral). 2016 .**

Abstract:
3D PC-MR imaging can provide measurements of blood ow velocities in three dimensions, providing data that can potentially allow us to obtain new insight of the cardiovascular system. Hemodynamics parameter as wall shear stress (WSS), oscillatory shear index (OSI), vorticity, helicity and energy, are important parameters for the assessment of the loss of vascular function, the integrity of the vessel tissue and the hemodynamic behavior. Several methods have been proposed to estimate these parameters from 3D PC-MRI, where the in-plane gradients of velocity on 2D planes are approximated through nite di erences or di erentiation of other interpolation schemes. However, such methods neglect the longitudinal velocity gradients that typically arise in cardiovascular ow, particularly on vessel geometries whose cross section and centerline orientation strongly vary in the axial direction. In this work we propose a 3D nite-element method for the quanti cation of di erent hemodynamics parameter from 3D PC-MRI that accounts for both in-plane and longitudinal velocity gradients in real geometries. We demonstrate the convergence and robustness of the method on cylindrical geometries using a synthetic phantom and CFD simulation. To show the medical applicability of the method, we compute 3D maps of di erent hemodynamics parameters for 3D CINE PC-MRI data sets from an aortic phantom and eighteen healthy volunteers and di erent patients. Our method improves the estimation of these hemodynamics parameters allowing for more accurate estimates in vessel with pathologies in that the out of plane information was impor- tant, such as coarctation and aneurysms. Also we avoid the used of reformatting 2D planes from 3D CINE PC-MRI and the use of pathlines that not cover the entire vessel, as the actual methods.

**Schwab C.; Jovanovic N.; Feger T.; Bakovic M.; Gurevich Y. V.; Stürmer J. ; Apodaca R.; Vanzi L.; Rukdee S.; …et al. (2016) Adaptive optics fed single-mode spectrograph for high-precision Doppler measurements in the near-infrared. Proc. SPIE 9912, Advances in Optical and Mechanical Technologies for Telescopes and Instrumentation II, 991274 (22 July 2016).**

**Abstract:**
We present the design for a high resolution near-infrared spectrograph. It is fed by a single-mode fiber coupled to a high performance adaptive optics system, leading to an extremely stable instrument with high total efficiency. The optical design is a cross-dispersed Echelle spectrograph based on a white pupil layout. The instrument uses a R6 Echelle grating with 13.3 grooves per mm, enabling very high resolution with a small beam diameter. The optical design is diffraction limited to enable optimal performance; this leads to subtle differences compared to spectrographs with large input slits.

**Urbina J., Montalba C. , Fernández T., Valenzuela F. Tejos , C., Irarrázaval P., Andía M., Valverde I., Uribe S. (2016). Realistic aortic phantom with a kinking of the aorta: one to one replica of a patient and comparison using PC-MRI and cardiac catheterization. 24th International Conference of the ISMRM, Singapur, May 2016 (e-Poster).**

Abstract:
Recently, 3D printing technology has emerged as a very innovative technique to produce patient-specific anatomical replicas with great precision. Therefore, the aim of this work was to generate a one to one replica of the aorta of a patient with a kinking and to compare the

hemodynamic parameters with the ones obtained from patient's PC-MRI and cardiac catheterization.

**Urbina J, Ruijsink B., Nordsletten D., Valverde I., Tejos C., Irarrázaval P., Andía M., Hurtado D., Uribe S. (2016). 3D quantification of Vorticity, Helicity, Kinetic Energy and Energy loss in the Left Ventricle from 4D flow data using a finite element method. 24th International Conference of the ISMRM, Singapur, May 2016 (e-Poster).**

Abstract:

The vortices that form during left ventricular (LV) filling are critical determinants of directed blood flow during ventricular ejection. Studies based on MRI, CFD simulation and echocardiography have revealed that vortices in the LV have a specific geometry and anatomical locations and any alteration of these characteristics affect directly the efficiency and ventricle workload1-6. However, most of these studies consist in a qualitative characterization of vortices in the LV, making use of 2D planes. In this work, we provide a fully quantitative characterization of vortex flow as turbulence (vorticity and helicity) and energy (kinetic energy and energy loss) in the LV.

**Urbina J., Montalba C., Tejos C., Irarrázaval P., Andía M., Valverde I., Uribe S. (2016). Accuracy of relative pressure measurements from 3D PC-MR data using realistic aortic coarctation phantoms. 24th International Conference of the ISMRM, Singapur, May 2016 (e-Poster).**

Abstract:Aortic coarctation is a narrowing of the descending aorta, which is typically located at the insertion of the ductus arteriosus just distal to the left subclavian artery. Pressure gradient across the coarctation is the most important hemodynamic parameter for clinical decisions. Cardiac catheterization is the gold standard technique to measure systolic pressure gradient in patients with aortic coarctation. However, it is an invasive technique, non-exempt of risk, patients are exposed to x-rays and is difficult to reproduce. 3D PC-MRI has the capacity to measure non-invasively the 3D-spatial and temporal evolution of complex flow patterns and analyze quantitative hemodynamics parameters. Perform a sensitivity study of 3D PC-MRI to calculate pressure gradient in cardiovascular patients under different physiological conditions is difficult. Vessel phantom studies have been performed in order to generate controlled experiments. Therefore, the aim of this work is to study the effects of the aortic segmentation, spatial resolution, cardiac output and severity of the aortic coarctation in the accuracy measurement of relative pressures from 3D PC-MRI compared with catheterization using a realistic aortic coarctation phantom with pulsatile flow.

**Urbina J. , Sotelo J. , Tejos C., Irarrázaval P., Andía M.,Valverde I., Hurtado D. , Uribe S. (2016). Characterization of coarctation flows with continuous 3D maps of energy loss, kinetic energy and turbulence parameters: novel 4D Flow MRI-Based quantification method using a finite element approach. 24th International Conference of the ISMRM, Singapur, May 2016 (Poster).**

Abstract:

Aortic Coarctations (CoA) are mainly characterized by its pressure drop. However the CoA also produces energy dissipation and turbulent flows posterior to the CoA, which can generate an irreversible damage in the surrounding tissue under mechanical stresses fluctuation1. Some MRI based methods have been proposed to calculate the energy loss and turbulence parameters2,3. These methods uses finite differences, however, this technique cannot handle the smooth and complex boundaries of the vessels in the cardiovascular system, and therefore induces important errors when the geometry is simplified4. In this work, we propose a new technology based on 4D Flow MRI and a finite element approach to provide 3D maps of energy loss, kinetic energy and turbulence parameters.

**Vargas Patricia, Sitaram Ranganatha, Sepúlveda Pradyumna, Montalba Cristian, Rana Mohit, Tejos Cristián , Ruiz Sergio (2016). Functional connectivity self-regulation of cerebellum and primary motor areas with fMRI-Brain Computer Interfaces. Pilot results. 24th International Conference of the ISMRM, Singapur, May 2016 (Poster).**

Abstract:

The aim of this study was to evaluate the feasibility of achieving volitional control of M1-cerebellum functional connectivity, in healthy subjects with an fMRI-BCI system. The results indicate that volitional self-regulation of cerebellum-M1 connectivity is feasible with fMRI-BCI. The data also suggests that cerebellum is more easily recruited than M1.

**Yoshito H. Ono, Oliver Lardière, David R. Andersen, Carlos M. Correia, Darryl Gamroth, Kathryn Jackson, Andrés Guesalaga, Olivier Martin, Shin Oya, Masayuki Akiyama, Colin Bradley (2016). SPIE. Astronomical Telescopes + Instrumentation. Edinburgh, Scotland, United Kingdom, 26 June–1 July.**

Abstract:

Prior statistical knowledge of the turbulence such as turbulence strength, layer altitudes, and wind speeds and directions is essential for atmospheric tomography in adaptive-optics (AO). These atmospheric parameters can be estimated from measurements of multiple Shack-Hartmann wave-front sensors (SH-WFSs). In this paper, we show the statistics of turbulence strength, layer altitudes, outer scale, and wind speeds and directions at Mauna Kea estimated from telemetry of multiple SH-WFSs of RAVEN, an on-sky multi-object AO demonstrator tested at the Subaru telescope. We provide statistics of the temporal evolution of atmospheric parameters as well as the temporal de-coherence of turbulence.

**Ono Yoshito H., Lardière Oliver, Andersen David R., Correia Carlos M., Gamroth Darryl, Jackson Kathryn, Guesalaga Andrés , Martin Olivier, Oya Shin, Akiyama Masayuki, Bradley Colin (2016). The statistics of atmospheric turbulence at Maunkea measured by RAVEN. SPIE. Astronomical Telescopes + Instrumentation. Edinburgh, Scotland, United Kingdom, 26 June–1 July.**

Abstract:

Prior statistical knowledge of the turbulence such as turbulence strength, layer altitudes, and wind speeds and directions is essential for atmospheric tomography in adaptive-optics (AO). These atmospheric parameters can be estimated from measurements of multiple Shack-

Hartmann wave-front sensors (SH-WFSs). In this paper, we show the statistics of turbulence strength, layer altitudes, outer scale, and wind speeds and directions at Mauna Kea estimated from telemetry of multiple SH-WFSs of RAVEN, an on-sky multi-object AO demonstrator tested at the Subaru telescope. We provide statistics of the temporal evolution of atmospheric parameters as well as the temporal de-coherence of turbulence.

## OTRAS PUBLICACIONES

**Izzo L., Cano Z., Ugarte Postigo A. de, Thoene C. (IAA-CSIC), Vanzi L., Zapata A., Espinoza N., D. Fernandez D. (PUC-Chile), Prieto J. L. (UDP/MAS), Bonifacio P. (GEPI-Obs. Paris), Della Valle M. (INAF-OAC), Molaro P. (INAF-OATs). Spectroscopic observations of Nova Lup 2016. The Astronomer's Telegram, 3 de Octubre 2016.**

**Abstract:**
We report spectroscopic observations of the Nova Lup 2016 (ATel #9538, #9539, #9550, #9564; CBET #4322), also known as ASASSN-16kt and PNV J15290182-4449409. A series (6x10 min exposures) of optical spectra were obtained with the 0.5 m telescope at the Pontificia Universidad Catolica de Chile Observatory at Santa Martina, Lo Barnechea (Santiago, Chile), equipped with the PUCHEROS echelle spectrograph on 2016 September 29.0. The observations cover the spectral range between 4250 and 6900 Angstrom at a resolution of \sim 0.25 Ang/pix at 5000 Ang. A preliminary analysis of the combined spectrum shows a bright Halpha P-Cygni profiles with blue shifted velocities centred at v $\sim$ -2250 and -3650 km/s. The emission line is characterised by a measured FWHM = 3700 km/s and FWZI = 7700 km/s. Similar results for the Hbeta line, for which we measure a larger FWZI = 9400 km/s, likely due to the presence of an underlying emission line on the red wing of the Hbeta line, probably due to Fe II 4924. We have also identified the other two lines of the Fe II multiplet 42, Fe II 5018, 5169, which do not show blue shifted velocities. We also report the presence of the He I 5876 and N II 5679 lines from their corresponding blue-shifted absorption centred at the velocity of v = -3650 km/s, that corresponds to the higher velocity component observed in Balmer lines. The low-ionisation transitions of Na I 5890 and 5686 also show a P-Cygni profile but centred at the velocity of v = -2250 km/s, that is the slower velocity component observed on the Halpha blue wing. Both Halpha and Hbeta lines show an asymmetric profile, that hints at the existence of multiple components. This will be clarified in the spectral evolution in the next few days. Given the rapid photometric evolution of Nova Lup 2016 (t3 $\approx$ 5 days), follow-up is strongly encouraged.

**Marconi A., Di Marcantonio P., D'Odorico V., Cristiani S., Maiolino R., Oliva E., Origlia L., Riva M., Valenziano L., Zerbi F. M., Abreu M., Adibekyan V., Allende Prieto C., Amado P. J…et al. (2016) EELT-HIRES the high-resolution spectrograph for the E-ELT. Conference Volume 9908. Ground-based and Airborne Instrumentation for Astronomy VI Christopher J. Evans; Luc Simard; Hideki Takami Edinburgh, United Kingdom, June 26, 2016.**

Abstract:
The first generation of E-ELT instruments will include an optic-infrared High Resolution Spectrograph, conventionally indicated as EELT-HIRES, which will be capable of providing unique breakthroughs in the fields of exoplanets, star and planet formation, physics and evolution of stars and galaxies, cosmology and fundamental physics. A 2-year long phase A study for EELT-HIRES has just started and will be performed by a consortium composed of institutes and organisations from Brazil, Chile, Denmark, France, Germany, Italy, Poland, Portugal, Spain, Sweden, Switzerland and United Kingdom. In this paper we describe the science goals and the preliminary technical concept for EELT-HIRES which will be developed during the phase A, as well as its planned development and consortium organisation during the study. 

## VI. CAPITULOS DE LIBROS

**Dixon, J. (2016) Power Electronics Converters and Systems; Chapter 2: "Multilevel Converters". Institute of Engineering and Technology (IET), págs 43-74. ISBN 978-1-84919-826-4.**

## VII. PROYECTOS DE INVESTIGACION

**ACT 11016 CONICYT P ROGRAMA DE INVESTIGACION ASOCIATIVA (2016-2018) Chilean Instrumentation for Astronomical Surveys Associate**
Investigador: Carlos Jerez
Monto asignado: 450.000K CLP

**Anillo (2015-2017) Magnetic resonance imaging technology for aging related diseases: brain, heart and vessels**
Director Pablo Irarrázaval
Monto total asignado: $450.000.000.-

**Anillo ACT 1417 (2015-2018) Instrumentación Chilena para Sondeos Astronómicos.**
Directo Alterno: Leonardo Vanzi
Monto asignado: $450.000.000.-

**Comité Mixto ESO-Gobierno de Chile. Astronomical Instrumentation Program at the Center of Astro Engineering UC.**
Investigador Responsable: Leonardo Vanzi
Monto asignado: 4.000.000

**Comité Mixto ESO-Gobierno de Chile. MOONS for the VLT - A Strategic Project for the Developmnet of Chilean Astronomical Instrumentation.**
Investigador Responsable: Leonardo Vanzi
Monto asignado: 30.000.000

**CORFO Prototipo 15IPPID-45837 (2015-2016) "Cámara Científica Sin Ruido"**
Investigador Responsable: Dani Guzmán
Monto asignado: $60.000.000.-

**CORFO (2015-2017) 15VEIID-45838. Validar y Empaquetar Sistema de Monitorización y Analizador de Calidad de Variables para el apoyo a la minería.**
Director Proyecto . Aldo Cipriano
Monto: Aporte Innova: $ 92.716.500

**ECOS CONICYT– UNIVERSIT´E PARIS VI FRANCE/CHILE (2016-2018) Multi-Mode Energy Harvesting for Future Systems**
Investigador principal: Carlos Jerez
Monto asignado: 24.2K USD

**EPSRC EP/K036327/1, (2014-2017) "Reconfigurable Distribution Networks", Imperial College London**
Investigador Asociado: Javier Pereda
Monto asignado: £1,223,860.- Total

**ETH ZURICH– PUC OPENSEEDFUNDSWITZERLAND/CHILE (2016) Advanced Boundary Element Methods and Computational Uncertainty Quantification in CEM**
Investigador Principal : Carlos Jerez
Monto asignado: 20K USD

**FONDAP (2013-2017) Centro Nacional de Investigación para la Gestión Integrada de Desastres Naturales, CIGIDEN**
Subdirector/Investigador Principal: Aldo Cipriano
Investigadores Asociados: Christian Oberli; Miguel Ríos: Miguel Torres
Monto asignado:$ 4.175.000.000 (total aporte Fondap 5 años)

**FONDAP-Centros de Excelencia 15110017 (2013-2018) National Research Center for Integrated Natural Disasters Management**
Investigador asociado: Miguel Ríos / Investigador asociado: Miguel Torres
Monto asignado:$4.800.000.- por año.

**FONDAP 15110019 (2013-2017) Centro de Investigación en Energía Solar (SERC-Chile)**
Investigador Asociado: Daniel Olivares
Monto asignado: $808.000.000.- por año.

**FONDAP-Centros de Excelencia 15110020 (2013-2018) Center for Sustainable Urban Development (CEDEUS)**
Investigador asociado: Miguel Ríos
Monto asignado: $2.400.000.- por año.

**FONDECYT-Iniciación 11140621 (2014-2017) Active Demand Response Mechanisms for Exploiting Flexibility in Electricity Supply: Models and Valuation**
Investigador responsible: Daniel Olivares
Monto asignado: $43.056.000.-

**FONDECYT 1130265 (2013-2016) Location and routing of undesirable ítems**
Investigador responsable: Vladimir Marianov
Coinvestigador: Miguel Ríos
Monto asignado:$25.180.000.-

**FONDECYT-Regular 1130334 (2013-2016) Application of multiple sampling and cryogenic operation for noise reduction in astronomical CCDs**
Investigador Responsable: Marcelo Guarini
Co-Investigador: Dani Guzmán / Coinvestigador: Christian Oberli / Coinvestigador : Angel Abusleme
Monto asignado: $127.000.000.-

**FONDECYT-Regular 1130379 (2013-2016) Development of contrast free magnetic resonance angiography and tissue perfusion techniques**
Coinvestigador: Claudia Prieto
Monto asignado: $82.094.000.-

**FONDECYT-Regular 1130849 (2013-2016) Development of high resolution spectroscopy techniques for astronomy**
Investigador Responsable: Leonardo Vanzi
Monto asignado: $124.470.000.-

**FONDECYT 1130887, (2013-2016) Topologically flexible prior shape knowledge for Level Set segmentations**
Investigador principal: Cristián Tejos
Monto asignado:

**FONDECYT 1141036, (2014-2018) Non-invasive 3D full-field Quantification of cardiovascular 4D flow MR images**
Co-investigador: Cristián Tejos
Monto asignado:

**FONDECYT 1141082 (2014-2016) NCRE Integration into the Chilean Electricity System: Opportunities for Solar Energy.**
Investigador principal: Hugh Rudnick
Coinvestigadores: David Watts / Matías Negrete Pincetic
Monto asignado: $27.520.000.-

**FONDECYT 1160236 (2016_2018) Point Spread Function Reconstruction in Tomographic Adaptative Optics.**
Investigador responsable: Andrés Guesalaga
Monto asignado: $ 56.300.000.-

**FONDECYT 1161055 (2016_2018) Free breathing 3D Cardiac Multiparametric Magnetic Resonance Fingerprinting.**
Investigador responsable: Claudia Prieto

**FONDECYT 1160025 (2016_2018) Competitive facility location and agglomeration.**
Investigador principal: Vladimir Marianov

**FONDECYT 1161448 (2016-2018) Improving Quantitative Susceptibility Mapping reconstruction methods based on MRI acquisitions.**
Investigador Responsable: Cristián Tejos
Co-investigadores: Marcelo Andia y Sergio Uribe

**FONDECYT 1161039 (2016-2018) Distributed Multi-Agent Control for the Internet of Things.**
Investigador responsable: Felipe Núñez
Monto asignado: $58.000.000

**FONDECYT-Regular 1150369 (2015-2018) Advanced Research in Adaptive Optics for Extremely Large Telescopes Director**
Investigador Responsable: Dani Guzman
Monto asignado: $170.000.000.-

**FONDECYT 11130513, (2013-2016) "Flexible Asymmetric Cascaded Multilevel Converters: Control and Modulation for Variable Voltage and Power Asymmetries in Real-time"**
Investigador Principal: Javier Pereda
Monto asignado: $71.267.000 Total

**FONDEF IDEA (2015-2016) Radiología Cuantitativa: Reportes Cuantitativos de Grasa Abdominal Total**
Director: Sergio Uribe
Director alterno: Pablo Irarrázaval
Investigadores: Marcelo Andia, Cristian Tejos, Loreto Muñoz
Monto asignado: $150.000.000.-

**FONDEF IT 13i 20015 (2014-1016) Wireless sensor networks: Developments of pre-market solutions**
Investigador responsable: Christian Oberli
Coinvestigador: Marcelo Guarini
Monto asignado: $177.497.000.-

**FONDEF IT16M10012 (2016-2018) Supervisión y control optimizante de relaves empleando tecnologías emergentes.**
Director responsable: Felipe Núñez
Director Alterno: Aldo Cipriano
Investigadores: C. Ledezma; E. Leiva; G Troni; JC Salas.
Monto asignado: $332.777.000

**Fondos de Desarrollo de la Astronomia Nacional Conicyt. 32130014. (2016-2018) Research Fellowship in Astronomical Instrumentation at the AIUC.**
Director Proyecto: Leonardo Vanzi
Monto asignado: 44.000.000.-

**GdF Suez Chile (2015-2016) Convenio para realizar el Desarrollo de un Polo Energético**.
Investigador responsable: Sebastián Ríos
Monto asignado: $6.000.000.-

**GMT-Harvard (2013-2016) G-Clef Collaboration with CfA.**
Director / Investigador Responsable: Dani Guzmán
Monto asignado:

**Internacionalización de la Investigación en Astrofísica, Cambio Global y Ciencias CognitivasVRI Etapa 1. INT 6288 (2016-2017) Internacionalización del Centro de Astro Ingeniería UC.**
Director Proyecto: Leonardo Vanzi
Monto asignado: 10.000.000.-

**NOTREDAME UNIVERSITY – PUC SEED FUND USA/CHILE (2016) Multi-Mode Energy Harvesting for Future Systems.**
Investigador principal: Carlos Jerez
Monto asignado: 24.2K USD

**QUICKWIN: MENTOR GRAPHICS CHILE (2015-2016) Improving preconditioning for commercial Maxwell BEM.**
Investigador principal: Carlos Jerez
Monto asignado: 10.000 K CLP

**QUIMAL – Conicyt 130006 (2014-2016) BOMBOLO: A Multi-Band Near-UV/Optical Imager for SOAR 4m Telescope.**
Director / Investigador Responsible: Dani Guzmán
Monto asignado: $180.000.000.-

**TEXAS A&M UNIVERSITY– PUC SEED FUND USA/CHILE (2016) Uncertainty Quantification in Engineering Design.**
Investigador Principal: Carlos Jerez
Monto asignado: 33.3K USD

**VDC 12 CTI-1678802 (2014-2017) Development of opportunities for wine conservation improvement /DICTUC – Centro de Aromas.**
Vice director: Christian Oberli
Coinvestigador: Marcelo Guarini
Monto asignado: $332.900.000.-

**ICM Instituto Milenio Instituto de Sistemas Complejos de Ingeniería.**
Director Suplente: Vladimir Marianov
Investigadores invitados: Matías Negrete-Pincetic y Daniel Olivares
Monto asignado: $800.000.000.- por año.

**Financiamiento Basal Instituto Milenio Instituto de Sistemas Complejos de Ingeniería.**
Director Suplente: Vladimir Marianov
Investigadores invitados: Matías Negrete-Pincetic y Daniel Olivares
Monto asignado: $1.200.000.000.- por año

**Disaster management and resilience in electric power systems (2016-2017) RCUK Newton– CONICYT (Chile) Research Partnerships, Newton Picarte Fund**
Director: Hugh Rudnick
Investigadores participantes: Juan Carlos de la Llera, Rodrigo Cienfuegos
Monto asignado: $120.000.000.-

**Proyecto PMI PUC 1206 (2016) Programa Acelerador III "Noise Reduction in Scientific CCDs: A disruptive innovation for the Photonics Industry".**
Director: Dani Guzmán
Alterno: Angel Abusleme
Monto asignado: 40.000.000