Informe Productividad 2015
Departamento de Ingeniería Eléctrica
Pontificia Universidad Católica de Chile

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INTRODUCCION

Durante el año 2015, el Departamento de Ingeniería Eléctrica de la Pontificia Universidad Católica de Chile ha continuado con su labor de formación de alumnos y 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 muestra un resumen de nuestros logros en materia de alumnos graduados, de publicaciones por los profesores e investigadores y ejecución de proyectos en sus distintas especialidades durante el año 2015.

Este informe incluye los siguientes contenidos:

Tesistas graduados del Programa de Doctorado en Ciencias de la Ingeniería, área Ingeniería Eléctrica.

Tesistas graduados del Programa de Magister en Ciencias de la Ingeniería, área Ingeniería Eléctrica.

Tesistas graduados del Programa de Magister en Ingeniería de la Energía.

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I. TESISTAS GRADUADOS DEL PROGRAMA DE DOCTORADO EN CIENCIAS DE LA INGENIERIÍA, ÁREA DE INGENIERÍA ELÉCTRICA

Tesista: Luer Villagra, Armin Mauricio
Tesis: "Extensions of fundamental hub location models"
Supervisor: Prof. Vladimir Marianov.
Fecha de la defensa: 13-10-2015.
Abstract:
This research is focused on the formulation and efficient solution of extensions of Fundamental Hub Location Problems (Fundamental HLPs), which belong to NP-hard for the non-trivial cases. HLPs aim at locating facilities known as hubs, in which the flows from multiple Origin-Destination (OD) pairs are consolidated, sorted and commuted, leading to the hub-and-spoke topology, commonly used, among others, in commercial aviation, parcel and courier delivery, and public transportation systems. Fundamental models assume that: (i) all the OD routes visit one or two hubs, (ii) the inter-hub network is complete, (iii) the company locating hubs is monopolistic and its demand is inelastic, and (iv) a constant discount factor is applied only to the flows between hubs. The main objective of this thesis is to extend the fundamental HLPs. We use three different approaches. Firstly, relaxing assumptions (i), (ii) and (iii), we formulate a competitive hub location and pricing problem, where an existing company operates a hub-and-spoke network and applies a fixed percentage of markup to their transportation services, and a newcomer designs its own hub-and-spoke network in order to maximize its profit. The users' behavior is modeled using a simple logit model. We derive a closed expression for the optimal pricing, when both network topologies are fixed. We solve the problem using a genetic algorithm. Finally, we show the pertinence of profit maximization as a competitive hub location objective, and the relevance of considering simultaneously competition and pricing in hub location. Secondly, we develop a modeling framework to help decision-makers to locate hubs. We formulate a mathematical model that is able to represent economies of scale, relaxing assumptions (i), (ii) and (iv). We use aggregate Key Performance Indicators (KPIs) to analyze the solutions obtained, showing the pertinence of our approach and the accuracy of the solutions obtained. Finally, we again relax assumptions (i), (ii) and (iv) and develop a single-allocation p-HLP in which the flow in any arc is discounted if it exceeds a predefined threshold. We formulate it as a Mixed-Integer Problem (MIP), and solve the model using standard mathematical programming software. In order to solve the test instances faster, we also develop a heuristic procedure. We show the pertinence of our assumptions, and the computational tractability of our exact model and heuristic procedure.

II. TESISTAS GRADUADOS DEL PROGRAMA DE MAGISTER EN CIENCIAS DE LA INGENIERIA, ÁREA DE INGENIERÍA ELÉCTRICA

Tesista: Dubost Alligier, Nicolás Sebastien.
Tesis: "Turbulence estimation in wide-field adaptative optics systems".
Supervisor: Prof. Dani Guzmán.
Fecha de la defensa: 29-07-2015.
Abstract:
The hypothesis of this work is the deviations and aberrations of an adaptive optics instrument can be quantified, and incorporated into a simulation, to train a tomographic reconstructor valid in experimental conditions. To do so, the test bench BEAGLE (Saez et ´al., 2014), a multi-object adaptive optics capable experiment that emulates CANARY at the William Herschel Telescope, is characterized. Parameters retrieved are employed to tune a simulation of the test bench, which produces validation data sets.
A technique is proposed to handle instrumental deviations, when measurements are made using a Shack-Hartmann (SH) wave-front sensor. Two deviations are addressed: subaperture heterogeneity and field-dependent aberrations. The first is due to on-axis static aberrations and imperfections in the Shack-Hartmann's construction. The second are the product of off-axis optical aberrations. The correction technique mitigates the deviations from the SH measurements before handing them over to an artificial neural network (ANN) based reconstructor. The intention is to present the ANN with normalized data, similar to that produced in simulation for its training.
When implemented, the correction fails to deliver any improvement. To address this, a sensitivity analysis is performed. As expected, the ANN is robust when facing noise. Because the proposed correction can be seen by the reconstructor as noise, its effects are limited. Other sources of error, such as atmospheric profile and pointing were tested as well. When these errors fall within expected orders of magnitude, their influence on the system's estimation is negligible, under 1%. The most significant variation in performance is observed when changing an atmospheric parameter: the outer scale. Further works remains to test all sources of error in an inclusive simulation and to train a new reconstructor that considers the incertitude in these factors.

Tesista: Durán Godoy, Tomás Antonio.
Tesis: "Nueva modulación vectorial continua y convertidor puente-H dual".
Supervisor: Prof. Javier Pereda.
Fecha de la defensa: 16-12-2015.
Resumen:
Las tecnologías de conversión de corriente continua a corriente alterna (DC-AC) han alcanzado altas calidades de voltajes y corrientes utilizando inversores multinivel. Estos inversores pueden generar un gran número de niveles de voltaje, reduciendo la distorsión de las ondas de voltaje alternas generadas. Sin embargo, los voltajes de salida son siempre discretos, por lo que siempre hay un contenido armónico remanente imposible de eliminar. Esta distorsión se puede

minimizar aumentando el número de niveles de voltaje generados por el inversor multinivel, sin embargo esto implica aumentar la cantidad de semiconductores requeridos y disminuir la confiabilidad del dispositivo.
La presente investigación propone una nueva modulación vectorial continua (C-SVM), la cual permite generar un voltaje sinusoidal de alta definición, reduciendo la distorsión armónica (THD) por debajo del 1 %. Esta modulación requiere dos fuentes de voltaje variables (por ejemplo conversores DC-DC), pero puede ser implementada en topologías simplificadas de inversores multinivel trifásicos. Es más, la modulación continua propuesta permite implementar una nueva topología de inversores multinivel trifásicos con una baja cantidad de semiconductores. La asimetría variable requerida se obtiene operando dos conversores DC-DC con un ciclo de trabajo variable. Esto permite introducir el concepto de modulación DC. El ciclo de trabajo variable sigue un patrón definido, el cual es una secuencia de hemiciclos sinusoidales positivos. Esta señal es modulada por ancho de pulso (PWM) y posteriormente filtrada, de modo de operar como fuente DC variable controlada para los inversores multinivel del sistema. Esto conlleva, sin embargo, un problema de corrientes resonantes en los convertidores DC-DC y pérdidas energéticas. Existe un trade-off entre la calidad de la onda trifásica generada por el sistema y la eficiencia energética.
Los resultados reales y de simulaciones muestran que las ondas de voltaje generadas son altamente sinusoidales. Sin embargo, el problema de las pérdidas energéticas deberá ser resuelto en investigaciones futuras, con miras a aplicaciones en la industria y en sistemas de potencia.

Tesista: Espinoza Lara, Sebastián Andrés.
Tesis: "Multi-phase resilience assessment and adaptation of electric power systems throughout the impact of natural disasters".
Supervisor: Prof. Hugh Rudnick.
Fecha de la defensa: 01-10-2015.
Abstract:
Around the world natural disasters, such as floods, ice and windstorms, hurricanes, tsunamis, earthquakes and other high impact and low probability events have affected countries' public security and economic prosperity. Furthermore, as a direct impact of climate change, the frequency and severity of some of these events is expected to increase in the future. This highlights the necessity of evaluating the impact of these events and investigating how man made systems can withstand major disruptions with limited service degradation and recover rapidly.
In this context, a multi-phase resilience framework is proposed here, which can be used to analyse any natural threat that may have a severe single, multiple and/or continuous impact on critical infrastructure, particularly electric power systems. Firstly, resilience assessment phases are presented: (i) threat characterization, (ii) vulnerability of the system's components, (iii) system's reaction and (iv) system's restoration. Secondly, multi-phase adaptation strategies, i.e., making the system more robust, redundant and responsive are explained to discuss different options to enhance the resilience of the network.
To illustrate the above, this time-dependent framework is applied to assess the impact of potential future windstorms and floods on a simplified version of the Great Britain's power system and to assess the impact of potential future earthquakes on a reduced version of the Northern Chilean Interconnected System. Finally the adaptation strategies are evaluated to

conclude in what situations a stronger, bigger or smarter grid is preferred against the uncertain future.

Tesista: Galarce Acevedo, Patricio.
Tesis: "Control de trayectoria de robots manipuladores móviles utilizando retroalimentación linealizante".
Supervisor: Prof. Miguel Torres.
Fecha de la defensa: 14-01-2015.
Resumen:
Esta tesis presenta el desarrollo de un controlador de posición para manipuladores móviles que considera la dinámica de la base y el brazo en forma conjunta y no de manera desacoplada como se realiza habitualmente. El controlador desarrollado corresponde a un control linealizante mediante retroalimentación no lineal de estado usando el modelo dinámico del manipulador móvil para anular los términos no lineales de las fuerzas y torques. Esta forma particular de linealización mediante retroalimentación no lineal del estado también es conocida como control por torque precalculado (CTP), y si bien es muy conocida en el ámbito de los robots manipuladores industriales, este trabajo extiende de manera novedosa la aplicación del método al caso de los robots manipuladores móviles. El CTP es validado en simulación como en experimentación, comparando su desempeño con respecto a un controlador por ejes basado en control proporcional-derivativo (PD) optimizado. Ambos controladores son aplicados a un manipulador móvil (MM) cuya base tiene tracción diferencial de giro deslizante y un brazo de tres grados de libertad (gdl.). El modelo considera el movimiento de la base móvil en el plano horizontal con tres gdl., dos de los cuales corresponden a la posición en el plano 2D y el tercero a la orientación (rumbo) de la base móvil, el brazo en cambio se mueve en el espacio 3D. Además otro aporte yace en el desarrollo del modelo dinámico del MM empleando el método recursivo de Newton-Euler para el cálculo de la dinámica inversa y una adaptación de la convención de Denavit-Hartenberg para incorporar la influencia de la base sobre el brazo y viceversa. Los resultados obtenidos muestran que a pesar de la incertidumbre en los parámetros del modelo, el CTP desarrollado tiene un mejor desempeño en términos del índice ITAE que el control PD optimizado. Esto se debe a que este último, si bien es más sencillo, no toma en cuenta la influencia de las perturbaciones que causan los movimientos de la base sobre el brazo, y viceversa.

Tesista: Kaulen Zegers, Diego.
Tesis: "Medium access control for MIMO Wireless sensor networks".
Supervisor: Prof. Christian Oberli.
Fecha de la defensa: 27-05-2015.
Abstract:
Sensor networks consist of autonomous wireless nodes that are networked together in an ad hoc fashion so as to monitor on or several variables that change over time and space. Transmissions between nodes are exposed to a varying MIMO (Multiple Input Multiple Output) channel. Channel state information (CSI) at both the transmitter and the receiver is needed to correctly transmit data between nodes. One way to obtain this information is through the Reverse Channel Training (RCT) scheme, which quickly acquires the necessary information but does not have a functional MAC layer that supports the coexistence of more than two nodes. Existent

MAC protocols are not compatible with this scheme, given that they need to send actual data in the first contact between nodes. Therefore, it is impossible to send operational data (such as node IDs, or addresses), jeopardizing the correct operation of the network addressing scheme.
In this thesis, a crossed-layer protocol is presented, where the addressing is achieved through multiple training signals (or preambles). These preambles must satisfy certain auto- and cross-correlation properties in order to provide correct medium access. Additionally, this protocol contemplates the development of a MAC layer compatible with the RCT scheme, allowing a correct initialization of the network. It will be shown that ten preambles suffice for a correct operation of the crossed-layer protocol in low density networks, since it allows more than 90% of the nodes to initialize correctly. The effective operation of the protocol is tested at both a physical layer level and at a MAC layer level.

Tesista: Meneses Díaz, Felipe Ignacio.
Tesis: "Specific features of a closed-en pipe blown by a turbulent jet: Aeroacoustics of the pampines".
Supervisor: Prof. Miguel Ríos.
Fecha de la defensa: 30-09-2015.
Abstract:
Flute-like instruments with a stopped pipe were widely used in ancient cultures and continue to be used in many musical expressions throughout the globe. They offer great flexibility in the input control parameters, allowing for large excursions in the flux and in the geometrical configuration for the lips of the instrumentalist. For instance, the transverse offset of the jet axis relative to the labium can be shifted beyond the operational limits found in open-open pipes, and the total jet flux can be increased up to values that produce highly turbulent jets while remaining on the first oscillating regime. Some of the fundamental aspects of the acoustics and hydrodynamics of this kind of instrument are studied, like the instability of the jet wave and the static aerodynamic balance in the resonator. A model for the Andean siku was constructed and a replica of the instrument was created an submitted to experiments of Schlieren flow visualization, yielding images of the blowing jet and pressure traces of the most relevant quantities. Image processing algorithms were developed in order to obtain quantitative measurements of the jet flow, which were used to validate the predictions of the model and fit other parameters.

Tesista: Montecinos Peña, Guillermo Andrés
Tesis: "El potencial de suministrar electricidad a comunidades indígenas y campesinas de Chile mediante microrredes híbridas solares-eólicas autogestionadas: Una propuesta de desarrollo comunitario sustentable para la electrificación rural en zonas aisladas".
Supervisor: Prof. David Watts.
Fecha de la defensa: 10-11-2015
Resumen:
América Latina, con una población de 617 millones de personas y un PIB per cápita cinco veces menor que Estados Unidos y Canadá, es una región que transita lentamente para salir del subdesarrollo. La desigualdad económica, el retrasado desarrollo humano y la insuficiente cobertura eléctrica rural plantean el desafío de re pensar las estrategias de electrificación rural,

desde las propias comunidades. América Latina reúne las condiciones culturales de asociatividad para desarrollar planes de electrificación autogestionados.
Por otro lado, las comunidades aisladas de Chile cuentan con los recursos naturales suficientes para auto abastecerse mediante fuentes renovables solar y eólico, concentrándose el mayor potencial solar en el norte del país, mientras que el mejor potencial eólico se concentra en el sur. La modelación correcta de la altitud es fundamental para no subestimar los costos eólicos y entregar señales erradas a comunidades altiplánicas de Bolivia, Chile y Perú.
Este trabajo desarrolla una propuesta de modelo de electrificación rural para comunidades aisladas indígenas y campesinas de Latinoamérica a partir del estudio del caso chileno, basado en la autogestión. Para ello se elaboró un catastro de comunidades aisladas de Chile, estudiándose la factibilidad técnico – económica de instalar sistemas eléctricos híbridos solar – eólicos con respaldo diesel.

Tesista: Oses Sánchez, Nicolás Ivori
Tesis: "Análisis espacio y temporal de la generación agregada de proyectos eólicos en los sistemas eléctricos en Chile".
Supervisor: Prof. David Watts
Fecha de la defensa: 23-11-2015
Resumen:
Gran parte de las ERNC presentan una dificultad significativa al estimar la variabilidad del recurso en la operación diaria de los parques. Dada esta problemática, se analiza la variabilidad propia del recurso eólico en Chile, mediante la modelación de 70 proyectos de generación eólica distribuidos a lo largo del país. Luego, se identifican las tendencias horarias locales en los perfiles de cada zona, se presentan curvas de costos de suministro eólico en las principales barras del estudio, identificando las barras más costo-eficientes para desarrollar proyectos eólicos. De manera complementaria, se calculan los coeficientes de correlación de la producción, entre cada par de proyectos, analizando las tendencias de diversificación de la generación, al aumentar la distancia de separación de los parques. El efecto de generación agregada se representa modelando las inyecciones de energía eólica en el Sistema de Transmisión Troncal; la generación de los proyectos es agregada en torno a las principales barras del sistema, la producción agregada de cada barra se visualiza mediante perfiles horarios e histogramas de generación, y la misma metodología es desarrollada para estimar la producción agregada de los sistemas eléctricos del norte y centro-sur del país (SING y SIC). Se calculan las probabilidades de excedencia de suministro eólico en cuatro escenarios de integración eólica al sistema: un parque, 12 parques (SING), 58 parques eólicos (SIC) y el total de 70 parques eólicos, en un escenario de interconexión SING-SIC. Finalmente, y como caso de estudio, se analiza la generación agregada de la zona de Calama en el norte del país, y se cuantifican los beneficios de la agregación eólica comparando la generación agregada, desde la inyección de un proyecto, hasta la inyección de seis proyectos eólicos de la zona. El estudio, ha permitido contribuir con el levantamiento más completo a la fecha del potencial de proyectos eólicos a nivel nacional, los cuales se podrán integrar en el sistema en el mediano plazo.

Tesista: Pinto Denegri, José Andrés.
Tesis: "Spectral elements for multiple trace formulation applied to scattering problems in two dimension".
Supervisor: Prof. Carlos Jerez.
Fecha de la defensa: 01-07-2015.
Abstract:
We present an efficient method to solve high-frequency scattering problems by heterogeneous penetrable objects in two dimensions. This is achieved by extending the so-called Local Multiple Traces Formulation, introduced recently by Hiptmair & Jerez-Hanckes, to purely spectral discretizations employing weighted Chebyshev polynomials. Together with regularization strategies to handle boundary integral operators singularities, matrix entries are quickly computed via the Fast Fourier Transform. The resulting Fredholm first-kind formulation is free from spurious resonances, and though ill-conditioned, it possesses built-in preconditioners based on Calderón-type techniques. Numerical results are presented in order to validate obtained for different settings validate the previous claims and greatly motivate future research in this direction.

Tesista: Sáez Vásquez, Norman Francisco.
Tesis: "Tecnologías para la medición de turbulencia atmosférica en tiempo real".
Supervisor: Prof. Dani Guzmán.
Fecha de la defensa: 22-07-2015.
Resumen:
Se ha comprobado que, del total de turbulencia óptica en telescopios terrestres, la turbulencia que se produce al interior de la cúpula del telescopio puede llegar a ser dominante en algunos casos. A diferencia de la turbulencia causada por la mezcla de aire a diferentes temperaturas en la atmósfera libre, la turbulencia al interior de un domo no se desarrolla completamente, ya que existen condiciones de borde definidas por la estructura de la cúpula y el mismo telescopio que la convierten en un proceso no modelable con las técnicas utilizadas para atmósfera libre. Es pertinente, en particular para la próxima generación de telescopios, los Extremely Large Telescope (ELT), desarrollar la capacidad de medir esta turbulencia. LOTUCE (LOcal TUrbulenCe Experiment) es un instrumento prototipo diseñado para medir este tipo de turbulencia. Se basa en lanzar rayos láser para definir líneas de base a varias distancias entre sí. La turbulencia produce un cambio de camino óptico diferente en cada uno de los láseres, lo cual puede medirse para calcular parámetros de la turbulencia apartir de estas mediciones. Estas mediciones deben efectuarse a alta velocidad. La primera versión del instrumento fue desarrollada por la universidad de Nice - Sofia Antipolis en colaboración con ESO. La Escuela de Ingeniería a través de un contrato DICTUC-ESO está a cargo del desarrollo de la segunda versión del instrumento, en el que se modificó su implementación para evitarlos problemas encontrados en la primera versión. La medición de la posición delos láseres se basa ahora en la operación simultánea de 4 cámaras de alta velocidad. Este trabajo contribuye con el desarrollo del software para la operación del instrumento, el cual está basado en el software de código abierto Durham Adaptive optics Real-time Computer (DARC). DARC fue modificado y ampliado, para permitir la operación de múltiples cámaras de alta velocidad y una interfaz de usuario fue desarrollada para la operación en línea y fuera de línea del instrumento.

Tesista: Sepúlveda Delgado, Pradyumna.
Tesis: "How feedback, mental imagery and reward influence brain self-regulation using real-time fMRI".
Supervisor: Prof. Cristián Tejos; Sergio Ruiz Poblete.
Fecha de la defensa: 22-12-2015.
Resumen:
El uso de *Neurofeedback* (NF) con resonancia magnética funcional en tiempo real (*Real-time fMRI neurofeedback*, rtfMRI) permite la auto-regulación de la actividad metabólica del cerebro. El control de la actividad cerebral puede generar cambios conductuales, lo cual abre nuevas oportunidades para potenciales aplicaciones tanto terapéuticas como de investigación en neurociencias. El proceso de aprendizaje involucrado en alcanzar auto-regulación de la actividad hemodinámica del cerebro se cree que está relacionado a factores como el tipo y contingencia del *feedback*, recompensa, el uso de imaginería mental, la duración del entrenamiento, entre otros. Instruir explícitamente a los participantes a usar imaginería mental es una práctica común en experimentos de rtfMRI-NF, bajo el supuesto de que esta estrategia mejorará y acelerará el proceso de aprendizaje. Del mismo modo, se asume que la entrega de recompensa monetaria según desempeño refuerza y mejora la auto-regulación cerebral. Sin embargo, la estrategia óptima para mejorar el control voluntario de la actividad cerebral aún no está clara. Para evaluar el efecto de estos factores en la auto-regulación, el presente estudio consideró la influencia de *feedback*, instrucciones explícitas y recompensa monetaria en el proceso de entrenamiento de sujetos sanos para aumentar la señal BOLD (*Blood Oxygen Level Dependent*, Dependiente del Nivel de Oxígeno Sanguíneo) en el Área Motora Suplementaria. Cuatro grupos fueron entrenados en un protocolo de rtfMRI-NF durante dos días: G_F sólo con NF, $G_{F,I}$ con NF + instrucciones explícitas (imaginería motora), $G_{F,R}$ con NF + recompensa monetaria, y $G_{F,I,R}$ con NF+ instrucciones explícitas (imaginería motora) + recompensa monetaria. Nuestros resultados muestran que G_F aumentó significativamente su auto-regulación de la actividad BOLD entre el día 1 y el día 2. $G_{F,R}$ mostró la mayor amplitud en la señal BOLD en la región objetivo durante el entrenamiento, pero no mostró un cambio significante entre el día 1 y día 2. Tanto $G_{F,I}$ como $G_{F,I,R}$ (grupos *con* imaginería motora) no mostraron una amplitud de la señal BOLD significativamente mayor que G_F ni tampoco cambios significativos entre el día 1 y día 2. El análisis univariado del cerebro reveló activaciones similares entre los cuatro grupos de entrenamiento. Igualmente, la conectividad funcional en regiones corticales motoras bilaterales y prefrontales mostró patrones comunes entre los cuatro grupos. Por otro lado, la variación de la conectividad funcional durante el entrenamiento presentó patrones distintos entre los grupos, representando las variadas influencias en el cerebro del *feedback*, recompensa e instrucciones.

Tesista: Venegas Jara, Joaquín Andrés.
Tesis: "Implementación de procesador banda-base MIMO".
Supervisor: Prof. Marcelo Guarini
Fecha de la defensa: 18-12-2015.
Resumen:
Actualmente no existe un desarrollo adecuado o suficiente de la tecnología en el ámbito de las comunicaciones de ancho de banda angosto y largo alcance. Sin embargo, este segmento de las comunicaciones se muestra especialmente adecuado para las redes inalámbricas de sensores que cubren grandes extensiones geográficas. Varios autores han propuesto utilizar algoritmos que emplean múltiples antenas (conocida como MIMO por sus siglas en inglés) para minimizar

la potencia total transmitida. No obstante, el desarrollo de las plataformas experimentales que permiten validar las investigaciones han apuntado en la dirección de esquemas de gran ancho de banda como WiMAX o LTE.

Esta tesis propone una metodología para diseñar e implementar un procesador banda-base y comprobar su funcionamiento en un dispositivo programable, en este caso una FPGA, para la investigación en redes inalámbricas de sensores MIMO. El procesador fue diseñado bajo las especificaciones del *testbed* desarrollado en el Laboratorio de Tecnologías Inalámbricas (LATINA) de la Pontificia Universidad Católica de Chile (PUC).

El procesador propuesto incluyó la características mínimas de un transceptor comercial, tales como: registros de configuración, interfaz de comunicación y procesamiento de señales en banda-base. Además, utilizando algoritmos desarrollados por investigadores en LATINA que solucionan aspectos de sincronización mediante el uso múltiples antenas, se diseñó una arquitectura de procesamiento que permitirá la posterior comprobación empírica de técnicas MIMO.

Finalmente, para validar el procesador se desarrolló en FPGA un emulador de canal discreto como medio para realizar simulaciones de Monte Carlo, y así comparar bajo un medio controlado la tasa de error de bit para distintas razones de señal a ruido entre la implementación y las simulaciones realizadas en MATLAB.

III. TESISTAS GRADUADOS DEL PROGRAMA DE MAGISTER EN INGENIERIA DE LA ENERGIA

Tesista: Aquea Zeballos, Andrés Nicolás.

Tesis: "Elementos paea un diseño óptimo de parques eólicos".

Supervisor: Prof. Sebastián Ríos

Resumen:

La investigación se propone como objetivo principal plantear una metodología de optimización, que permita obtener la configuración óptima de un parque eólico, desde el punto de vista de la rentabilidad financiera del proyecto, sujeto a restricciones técnicas, económicas, ambientales y sociales. La metodología propuesta se plantea como un instrumento de apoyo a las labores de diseño de parques eólicos de tipo onshore, con el ánimo de asistir al desarrollador del proyecto en la toma de decisiones, desde las etapas tempranas de evaluación. El trabajo analiza las bases teóricas que determinan el desempeño de los parques eólicos, y propone un modelo que relaciona ingresos y costos con la configuración física del parque eólico, y aplica estrategias de optimización basadas en algoritmos genéticos para encontrar el óptimo del problema. El modelo se hace cargo del cálculo de la producción de energía considerando pérdidas por efecto estela entre turbinas y por efecto Joule en las instalaciones eléctricas, calcula los costos de inversión, evalúa el proyecto y como resultado propone la configuración física del parque que más se ajusta a los criterios de optimización establecidos. El modelo se aplica al estudio de casos de parques eólicos reales e hipotéticos, con el fin de analizar la validez de la metodología desarrollada. Los resultados obtenidos dan cuenta de configuraciones que satisfacen los criterios de optimización definidos en relación a la maximización de la rentabilidad del proyecto, con respeto cabal a las restricciones, y se verifica que las posiciones de las turbinas resultantes, son consistentes con los criterios de minimización de las pérdidas por efecto estela. Finalmente, se plantea la conveniencia de realizar estudios matemáticos posteriores referentes al análisis de la convexidad del problema de optimización, con el fin de estudiar de forma detallada, la existencia de un óptimo global para el problema definido.

III. MEMORISTAS TITULADOS DE INGENIERO CIVIL

Memorista: Alvarado Meléndez, Gustavo Alberto.
Memoria: "Modelación, simulación y medición en terreno de armónicas en sistemas de potencia industriales de gran escala".
Ingeniero Civil Electricista
Supervisor: Prof. Sebastián Ríos.
Resumen:
En esta Memoria se realiza un estudio de armónicos del sistema eléctrico de una faena minera perteneciente a la Gran Minería de Chile. Para llevar a cabo este estudio se construyó un modelo matemático de 176 barras, en el cual se representaron las principales cargas no lineales del sistema eléctrico por sus espectros armónicos reales.
Los resultados de las simulaciones obtenidas en el modelo, fueron validados utilizando mediciones realizadas en terreno. Además, se analizó la impedancia del sistema en el dominio de la frecuencia.
Con el modelo matemático validado y habiendo estudiado la impedancia del sistema en el dominio de la frecuencia, se procedió a realizar el estudio de flujo de carga armónico para 37 casos de estudio.
En vista de los resultados obtenidos de las simulaciones, se llegó a la conclusión de que existen condiciones de operación que producen frecuencias de resonancia que pueden ser excitadas por las corrientes armónicas existentes en el sistema eléctrico de la División Los Bronces, con lo cual se pueden vulnerar algunos de los límites de armónicos estipulados en la Norma Técnica Chilena. Del mismo modo, se llega a la conclusión que los bancos de condensadores de la subestación Maitenes están expuestos a corrientes y voltajes armónicos, lo cual podría explicar la constante falla de estos equipos.
Finalmente, en vista de los resultados obtenidos de la simulación de flujo de carga armónico, se realiza una serie de recomendaciones con el objetivo de permitir la operación segura de la División Los Bronces

Memorista: Chauveau Gerber, Paul.
Memoria: "Análisis de redes organizacionales y su impacto en el desempeño de proyectos en una empresa minera".
Ingeniero Civil de Industrias, con Diploma en Ingeniería Eléctrica
Supervisor: Prof. Cristóbal García.
Resumen:
La memoria aborda la relación entre la estructura de red de comunicaciones electrónicas y el desempeño laboral en tres compañías de un grupo minero Chileno. Utilizando las metodologías de análisis de redes sociales y análisis estadístico, se encontraron diferencias en la relación entre el desempeño laboral y la estructura de red entre los equipos que pertenecían a las comunidades de práctica y aquellos que no pertenecían a estas comunidades. El análisis también estudió el efecto de la centralidad de los líderes de cada equipo, encontrando evidencia respecto a la relación entre roles protagónicos de líderes y baja en el desempeño. Finalmente se encontró una relación positiva en los resultados de cada equipo cuando el equipo completo

ganaba centralidad en las redes externas. La memoria concluyen con una discusión de estos resultados y con recomendaciones para la gestión de equipos y de las comunicaciones entre las redes organizacionales.

Memorista: Hernández Caldumbide, Camilo Andrés.
Memoria: "Detección y transmisión de señales sísmicas para la implementación de un sistema de alerta temprana de terremotos ".
Ingeniero Civil Electricista
Supervisor: Prof. Miguel Ríos.
Resumen:
Los terremotos son uno de los desastres naturales más destructivos del mundo y los más destructivos de Chile. Si bien aún no es posible predecir cuándo y dónde ocurrirán se han desarrollado métodos para alertar a la población una vez que el sismo ha comenzado, pero antes de que llegue a los centros urbanos. En esta memoria se modelará un sistema de alerta temprana de sismos para Chile.
En la introducción se detallan las características de los sismos en general y de su actividad en Chile en particular. Luego se describen las distintas fases de la gestión de desastres naturales, que es una serie de procedimientos y estrategias destinadas a reducir los daños causados por éstos.
En el estado del arte se describen varios sistemas de alerta temprana que operan actualmente en el mundo, como en Japón y Taiwán, así como el procedimiento teórico con el cual procesan la información.
En la modelación se describen los sensores que se usarán en el modelo de la red de alerta temprana. Además se explica detalladamente el proceso de modelamiento de la red, cómo se analizarían los datos provenientes de los sismos y el proceso de determinar la cantidad de sensores, así como sus posiciones óptimas. Los resultados muestran que los sistemas con más tiempo de alerta, son un sistema de 41 sensores con comunicación radial ad-hoc y un sistema de 38 sensores con comunicación satelital.
En las conclusiones se discute que el sistema más eficiente, tanto en costos como tiempo de alerta, es un sistema de 41 sensores con comunicación radial ad-hoc, ya que el sistema satelital ofrece una mejora marginal del tiempo de alerta a un costo demasiado alto.

Memorista: Rodríguez Aedo, Ignacio.
Tesis: "Estadísticas de turbulencia atmosférica en cerro Pachón utilizando telemetría láser".
Ingeniero Civil Electricista
Supervisor: Prof. Andrés Guesalaga.
Resumen:
El conocimiento en torno de la turbulencia óptica atmosférica es clave para los telescopios, para elegir el lugar de construcción, su diseño y su funcionamiento. En particular para la optimización de los instrumentos y de los sistemas de óptica adaptativa que, con elementos ópticos dinámicos, compensan los efectos de la turbulencia para determinadas alturas. Con algoritmos tomográficos desarrollados en el AIUC se trabajó en obtener información estadística del perfil de turbulencia óptica atmosférica sobre el telescopio Gemini South ubicado en Cerro Pachón, La Serena. El trabajo realizado es el orden y depuración de datos de telemetría

recolectados a lo largo de tres años para obtener información tomográfica y junto al análisis estadístico e interpretación de estos resultados en relación al desempeño actual del telescopio y sus posibles mejoras. La información tomográfica estimada es el perfil de turbulencia atmosférica. Esta información es generada para entender el comportamiento de las diferentes capas turbulentas e identificar el aporte de cada una de ellas en vistas a la optimización del sistema óptico. Se utilizaron y compararon dos métodos previamente implementados, inversión de matriz y deconvolución, con el fin de identificar cuál de ellos tiene un mejor desempeño bajo los diferentes escenarios a los que está sometido el telescopio en el tiempo. Se identificó que para los algoritmos utilizados el método por deconvolución opera mejor, sin subestimar la turbulencia. Con los análisis realizados, se pudo identificar las capas donde el sistema de óptica adaptativa debe poner énfasis a la hora de compensar. Según estos, el sistema tiene un buen desempeño pero puede ser mejorado. Para ello, destaca particularmente que se debe mejorar la conjugación en las capas bajas de la atmósfera y la modelación de la turbulencia al interior del domo antes de reintegrar el espejo deformable retirado hace tres años. La importancia de este trabajo, su análisis y conclusiones reside en el uso de datos reales, utilizando el sistema de óptica adaptativa multi-conjugada de Gemini South, GeMS, como sensor. Dados los resultados obtenidos, se verifica la factibilidad y validan que el método de estimación del perfil de turbulencia se podría integraren GeMS en vistas a tener una estimación contemporánea en tiempo real y así optimizar el sistema de óptica adaptativa

Memorista: Ropert Rossel, Samuel Juan María.
Tesis: "Diseño y desarrollo del sistema de control del espectrógrafo de alta resolución FIDEOS".
Ingeniero Civil Electricista
Supervisor: Prof. Leonardo Vanzi.
Resumen:
En esta memoria de título se presenta el trabajo realizado en el marco del desarrollo del espectrógrafo de alta resolución FIDEOS, que se instalará en el observatorio La Silla, y que está optimizado para la medición de velocidades radiales, y por consiguiente la búsqueda de exoplanetas a través de éste método. Este trabajo se compone de dos proyectos de control independientes.
En primer lugar se presenta el diseño, desarrollo e implementación del sistema de control del módulo de calibración del espectrógrafo. Este sistema de control fue desarrollado tanto a nivel de Hardware como de Software, lo que incluye tanto la comunicación como el control de los actuadores involucrados. Además se explica el proceso de integración de este sistema con los elementos ópticos del módulo de calibración.
En segundo lugar se presenta el proceso de experimentación y diseño realizado en torno al desarrollo del sistema de control térmico del espectrógrafo FIDEOS, el cual es un elemento fundamental para poder alcanzar la precisión deseada en este tipo de instrumentos. Acá se presenta la estructura de este tipo de sistema de control y se justifica la experimentación y posterior elección de los elementos utilizados en el sistema de control térmico final.

Memorista: Solari Irribarra, Isabella.
Memoria: "Comportamiento en el consumo eléctrico de algunos clientes residenciales santiaguinos ante la implementación de una tarifa eléctrica flexible".
Ingeniero Civil de Industrias, con Diploma en Ingeniería Eléctrica
Supervisor: Prof. Enzo Sauma.
Resumen:
El mercado eléctrico chileno se encuentra en su mayor parte desregularizado. Sin embargo, la comercialización sigue ligada a la actividad de distribución eléctrica a nivel residencial. En diversas partes del mundo estas actividades se están separando, permitiendo la incorporación de libre competencia a nivel de comercialización y por tanto la proliferación de distintos planes tarifarios que se adecuen a los clientes. Dentro de estos planes está la llamada tarifa Time-of-Use, que fue la escogida para el análisis de los potenciales beneficios que traería su incorporación en el contexto de clientes residenciales santiaguinos.
A través de una encuesta, se obtuvieron los comportamientos de consumo habituales de 45 familias de Santiago de Chile, cuatro de los cuales sirvieron de input para el modelo de optimización de dichos patrones. Las restricciones respecto a los cambios permitidos en los patrones de consumo se adecuaron a las rutinas factibles de los casos evaluados, tal que los ahorros obtenidos fueran conservadores. A su vez, se evaluaron escenarios donde se incorporaban artefactos de climatización.
Los resultados indican que el ahorro potencial sin artefactos estacionales podía llegar hasta el 10,11% en la tarifa Time-of-Use con respecto a la tarifa plana. Dentro de los factores relevantes en el cálculo del ahorro están la flexibilidad de la familia en el cambio de sus rutinas y la intensidad del consumo eléctrico (magnitud de la cuenta y existencia de climatización eléctrica). El modelo posee el valor agregado de que se puede adaptar a las rutinas de uso de artefactos que la familia está dispuesta a incorporar. Finalmente, cabe destacar que los perfiles encontrados resultaron diferentes, lo que refuerza la idea de que no todos los clientes calzamos en un perfil.

IV. PUBLICACIONES EN REVISTAS ISI

Abramowicz H., Abusleme A., Afanaciev K., et al (2015) Performance of fully instrumented detector planes of the forward calorimeter of a Linear Collider detector. Journal of Instrumentation, 10, P05009, 26pp

Abstract**:**
Detector-plane prototypes of the very forward calorimetry of a future detector at an e+e− collider have been built and their performance was measured in an electron beam. The detector plane comprises silicon or GaAs pad sensors, dedicated front-end and ADC ASICs, and an FPGA for data concentration. Measurements of the signal-to-noise ratio for different feedback schemes and the response as a function of the position of the sensor are presented. A deconvolution method is successfully applied, and a comparison of the measured shower shape as a function of the absorber depth with a Monte-Carlo simulation is given.

Aguirre-Reyes D.F., Sotelo J.A., Arab J.P., Arrese M., Tejos R., Irarrázaval P., Tejos C., Uribe S., Andia M.E. (2015) Intrahepatic portal vein blood volume estimated by non-contrast magnetic resonance imaging for the assessment of portal hypertension. Magnetic Resonance Imaging 33 8 970-977.

Abstract:
Purpose: To investigate the feasibility of estimating the portal vein blood volume that flows into the intrahepatic volume (IHPVBV) in each cardiac cycle using non-contrast MR venography technique as a surrogate marker of portal hypertension (PH). Materials and methods Ten patients with chronic liver disease and clinical symptoms of PH (40% males, median age: 54.0, range: 44–73 years old) and ten healthy volunteers (80% males, median age: 54.0, range: 44–66 years old) were included in this study. A non-contrast Triple-Inversion-Recovery Arterial-Spin-Labeling (TIR-ASL) technique was used to quantify the IHPVBV in one and two cardiac cycles. Liver (LV) and spleen volumes (SV) were measured by manual segmentation from anatomical MR images as morphological markers of PH. All images were acquired in a 1.5 T Philips Achieva MR scanner. Results PH patients had larger SV (P = 0.02) and lower liver-to-spleen ratio (P = 0.02) compared with healthy volunteers. The median IHPVBV in healthy volunteers was 13.5 cm3 and 26.5 cm3 for one and two cardiac cycles respectively, whereas in PH patients a median volume of 3.1 cm3 and 9.0 cm3 was observed. When correcting by LV, the IHPVBV was significantly higher in healthy volunteers than PH patients for one and two cardiac cycles. The combination of morphological information (liver-to-spleen ratio) and functional information (IHPVBV/LV) can accurately identify the PH patients with a sensitivity of 90% and specificity of 100%. Conclusion Results show that the portal vein blood volume that flows into the intrahepatic volume in one and two cardiac cycles is significantly lower in PH patients than in healthy volunteers and can be quantified with non-contrast MRI techniques.

Aitken P.A, Henningsson M., Botnar R.M., Schaeffter T., Prieto C. (2015) 100% Efficient three-dimensional coronary MR angiography with two-dimensional beat-to-beat translational and bin-to-bin affine motion correction. Magnetic Resonance in Medicine 74 3 756-764

Abstract:
Purpose: To develop a flexible image navigator for 3D coronary MR angiography that allows respiratory motion of variable complexity to be compensated for on different temporal scales. Methods: A two-dimensional (2D) golden radial image navigator is proposed; translational motion is compensated for on a beat-to-beat basis, and residual affine motion is compensated for on a bin-to-bin basis in a two-step procedure. The method does not use a respiratory gating window and therefore achieves 100% scan efficiency and a predictable scan time. The proposed method was tested in 11 healthy volunteers and compared against a navigator-gated and tracked acquisition. Results: The proposed method achieved comparable quantitative and qualitative image quality to a 6-mm navigator-gated and tracked scan while reducing the scan time by a factor of approximately 2. Combined motion correction using image navigators improved visualization of the coronary arteries in four of 11 subjects in comparison with translational correction only, and image quality was maintained in the remaining cases. In one case, visualization of the left anterior descending coronary artery was degraded using combined correction compared with translation correction only. Conclusions: The feasibility of correcting for 2D translational motion on a beat-to-beat basis as well as affine motion on a bin-to-bin basis has been demonstrated.

Alessandri, C., Abusleme, Angel, Guzmán, D., Passalacqua, I., Alvarez-Fontecilla, E., Guarini, M. (2015) Optimal CCD readout by digital correlated doublé sampling. Monthly Notices of the Royal Astronomical Society 455, 1443-1450.

Abstract:
Digital correlated double sampling (CDDS), 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 analyze 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.

Alvarez, E. ; Abusleme, A. (2015) Passive Reference Sharing SAR ADC. Microelectronics Journal 46, 8, 750–757

Abstract:
Charge-redistribution successive approximation register (SAR) analog-to-digital converters (ADCs) are widely used for their simple architecture, inherent low-power consumption and small footprint. Several techniques aiming to reduce the power consumption, to increase the speed, and to reduce the capacitance spread have been developed, such as splitting the digital-to-analog converter (DAC) capacitor array, and charging and discharging the DAC capacitors in multiple steps. In this paper, a fully differential, low-power, passive reference voltage sharing SAR ADC architecture is presented, along with its theoretical analysis and test results. In this architecture, suitable for low sampling rate and low-resolution applications, the reference voltage is scaled down by successively connecting equally sized capacitors in parallel, allowing the use of small capacitor for its implementation. The implemented 6-bit ADC is one of the smallest ADCs reported in a 180-nm technology, and features a FoM between 30.8 and 39.3 fJ per conversion step without considering the clock generator power consumption.

Arnold, D.B., Negrete-Pincetic, M., Sankur, M.D., Auslander, D.M., Callaway, D.S., "Model-Free Optimal Control of VAR Resources in Distribution Systems: An Extremum Seeking Approach," in , IEEE Transactions on Power Systems, vol.PP, 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., Guivant J., Sanz R., Escolà A., Yandún F., Torres M., Rosell-Polo J.R. (2015) Real-time approaches for characterization of fully and partially scanned canopies in groves. Computers and Electronics in Agriculture 118 361–371

Abstract:
Efficient information management in orchard characterization leads to more efficient agricultural processes. In this brief, a set of computational geometry methods are presented and evaluated for orchard characterization; in particular, for the estimation of canopy volume and shape in groves and orchards using a LiDAR (Light Detection And Ranging) sensor mounted on an agricultural service unit. The proposed approaches were evaluated and validated in the field, showing they are convergent in the estimation process and that they are able to estimate

the crown volume for fully scanned canopies in real time; for partially observed tree crowns, accuracy decreases up to 30% (the worst case). The latter is the major contribution of this brief since it implies that the automated service unit does not need to cover all alley-ways for an accurate modeling of the orchard, thus saving valuable resources. Keywords: Crown volume; LiDAR sensor; Mobile terrestrial laser scanner; Agricultural robotics.

Basaure A., Marianov V., Paredes R. (2015) Implications of dynamic spectrum management for regulation. Telecommunications Policy, 39, 7, 563–579.

Abstract:
The Coase theorem suggests that a regulatory scheme which clearly defines spectrum property rights and allows transactions between participants, induces an optimal spectrum assignment. This paper argues that the conditions required by Coase are gradually achieved by the introduction of Dynamic Spectrum Management (DSM), which enables a dynamic reassignment of spectrum bands at different times and places. DSM reduces the costs associated with spectrum transactions and thus provides an opportunity to enhance efficiency through voluntary transactions. This study analyzes the factors affecting the benefits under a spectrum regime based on this theorem, compares and quantifies the potential gains associated with different regulatory schemes by employing agent-based simulations and suggests policy implications for spectrum regulation.

Bronfman A., Marianov A., Paredes-Belmar G. and Lüer-Villagra A. (2015) The maximin HAZMAT routing problem. European Journal of Operational Research, 241, 1, 15 – 27.

Abstract:
The hazardous material routing problem from an origin to a destination in an urban area is addressed. We maximize the distance between the route and its closest vulnerable centre, weighted by the centre’s population. A vulnerable centre is a school, hospital, senior citizens’ residence orthe like, concentrating a high population or one that is particularly vulnerable or difficult to evacuate in a short time. The potential consequences on the most exposed centre are thus minimized. Though previously studied in a continuous space, the problem is formulated here over a transport (road) network. We present an exact model for the problem, in which we manage to significantly reduce the required variables, as well as an optimal polynomial time heuristic. The integer programming formulation and the heuristic are tested in a real-world case study set in the transport network in the city of Santiago, Chile.

Charlin D., Rudnick H., Araneda J.C. (2015) Expansión de la transmisión bajo incertidumbre en el sistema chileno via Minmax Regret y algoritmos genéticos. IEEE Latin America Transactions, 13, 3, 698-706.

Abstract:
Transmission planning has been broadly studied through the development of minimum cost models, adapting to the forecasts of generator and consumer requirements. This research considers that a single planner determines the transmission system expansion, while the generation expansion is decided by different independent market agents, and generation supply becomes an uncertainty, hampering the planner's decision making. Under this context, the

planner's and the generation market agents' individual decisions are in a constant struggle because the planner does not decide installing a line unless there is certainty that a power station will be installed, and vice versa. The methodology proposed develops a dynamic expansion model that minimizes the maximum regret, allowing the definition of a robust transmission system expansion. In addition, a heuristic tool is used through genetic algorithms to provide the planner with a ranking of the best configurations. The tool proposed will be useful for the planner, allowing to decide considering the uncertainty of the decisions of the generation market agents.

Coronado J., Helminiak K.G., Vanzi L., Espinoza N., Brahm R., Jordán A., Catelan M., Ratajczak M., Konacki M. (2015) Orbital and physical parameters of eclipsing binaries from the ASAS catalogue – VII. V1200 Centauri: a bright triple in the Hyades moving group. Monthly Notices of the Royal Astronomical Society, 448, 1937-1944.

Abstract:
We present the orbital and physical parameters of the detached eclipsing binary V1200 Centauri (ASAS J135218-3837.3) from the analysis of spectroscopic observations and light curves from the All-Sky Automated Survey (ASAS) and SuperWASP (Wide Angle Search for Planets) data base. The radial velocities were computed from the high-resolution spectra obtained with the OUC (Observatorio Universidad Católica) 50-cm telescope and PUCHEROS (Pontificia Universidad Católica High Echelle 1.2-m Euler telescope and CORALIE spectrograph using the cross-correlation technique TODCOR. We found that the absolute parameters of the system are M1 = 1.394 ± 0.030 M⊙, M2 = 0.866 ± 0.015 M⊙, R1 = 1.39 ± 0.15 R⊙, R2 = 1.10 ± 0.25 R⊙. We investigated the evolutionary status and kinematics of the binary and our results indicate that V1200 Centauri is likely a member of the Hyades moving group, but the largely inflated secondary's radius may suggest that the system may be even younger, around 30 Myr. We also found that the eclipsing pair is orbited by another, stellar-mass object on a 351-d orbit, which is unusually short for hierarchical triples. This makes V1200 Cen a potentially interesting target for testing the formation models of multiple stars.

Cruz G., Atkinson D., Buerger C., Schaeffter T., Prieto C. (2015) Accelerated motion corrected three-dimensional abdominal MRI using total variation regularized SENSE reconstruction Magnetic Resonance in Medicine. Reson Med. doi: 10.1002/mrm.25708

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.

Dias-Oliveira A., Sicardy B., Lellouch E., Vieira-Martins R., Assafin M., Camargo J.I.B., Braga-Ribas F., Gomes-Júnior A.R., Benedetti-Rossi G., Colas F., Decock A., Doressoundiram A., Dumas C., Emilio M., Fabrega Polleri J., Gil-Hutton R., Gillon M., Girard J. H., Hau G. K. T., Ivanov V. D., Jehin E., Lecacheux J., Leiva R., López-Sisterna C., Mancini L., Manfroid K., Maury A., Meza E., Morales N., Nagy L., Opitom C., Ortiz J. L., Pollock J., Roques F., Snodgrass C., Soulier J. F., Thirkin A., Vanzi L. Widemann T., Reichart D. E., LaCluyze A. P., Haislip J. B., Ivarsen K. M., Dominik M., Jorgensen U., Skottfelt J. (2015) PLUTO's Atmosphere from stellar occulations in 2012 and 2013. Astrophysical Journal 811 1 20

Abstract:

We analyze two multi-chord stellar occultations by Pluto that were observed on 2012 July 18th and 2013 May 4th, and respectively monitored from five and six sites. They provide a total of fifteen light curves, 12 of which were used for a simultaneous fit that uses a unique temperature profile, assuming a clear (no haze) and pure N2 atmosphere, but allowing for a possible pressure variation between the two dates. We find a solution that satisfactorily fits (i.e., within the noise level) all of the 12 light curves, providing atmospheric constraints between ~1,190 km (pressure ~ 11 \mubar) and ~ 1,450 km (pressure ~0.1 \mubar) from Pluto's center. Our main results are: (1) the best-fitting temperature profile shows a stratosphere with strong positive gradient between 1,190 km (at 36 K, 11 \mubar) and r = 1,215 km (6.0 \mubar), where a temperature maximum of 110 K is reached; above it is a mesosphere with negative thermal gradient of -0.2 K/km up to ~ 1,390 km (0.25 \mubar), where, the mesosphere connects itself to a more isothermal upper branch around 81 K; (2) the pressure shows a small (6 %) but significant increase (6-\sigma level) between the two dates; (3) without troposphere, Pluto's radius is found to be R_P = 1,190 +/- 5km.Allowing for a troposphere, RP is constrained to lie between 1168 and 1195 km; and (4) the currently measured CO abundance is too small to explain the mesospheric negative thermal gradient. Cooling by HCN is possible, but only if this species is largely saturated. Alternative explanations like zonal winds or vertical compositional variations of the atmosphere are unable to explain the observed mesospheric negative thermal gradient.

Escalona P., Ordoñez F., Marianov V. (2015) Joint location-inventory problem with differentiated service levels using critical level policy. Transportation Research Part E-Logistics and Transportation Review 83 141-157

Abstract:
This paper analyzes the design of a distribution network for fast-moving items able to provide differentiated service levels in terms of product availability for two demand classes (high and low priority) using a critical level policy. The model is formulated as a MINLP with chance constraints for which we propose a heuristic to solve it. Although the heuristic does not guarantee an optimal solution, our computational experiments have shown that it provides good-quality solutions that are on average 0.8% and at worst 2.7% from the optimal solution.

Eiselt H. A., Marianov V, (2015) Location Modeling for Municipal Solid Waste Facilities. Computers & Operations Research 62, 305-315.

Abstract:
This paper introduces the landfill siting problem by way of (usually ill-fated) examples. It thendiscusses different classes of decision-making models and formulates a generic cost-minimizationmodel for that purpose. It continues to describe some multi-criteria decision models that have beenused for landfill siting. The paper then surveys landfill location models that have appeared in theliterature during the last forty years. The work concludes with a framework that “zooms in” and usesexisting techniques to determine sites for solid waste facilities.

Furong L., Marangon-Lima, J.W., Rudnick, H., Medeiros Marangon-Lima, L., Padhy, N.P., Brunekreeft, G., Reneses, J., Chongqing Kang. (2015) Distribution Pricing: Are We Ready for the Smart Grid?. IEEE Power and Energy Magazine,, vol.13, no.4, , July-Aug. pp.76-86.

Abstract:
Energy transportation costs typically make up a quarter of consumers? electricity bills, and most of this amount (90% in the United Kingdom, 75% in Brazil and Spain, and 60% in India, for example) is due to energy transportation through the distribution network. This cost could escalate over the next few decades as distributed energy resources are expected to grow substantially in response to the financial incentives many governments have created for renewable and efficient generation to meet their CO_2 reduction targets.

García-Rissman A., Guesalaga A., Kolb J., Le Louarn M., Madec P-Y., Neichel B. (2015) Validation through simulations of a C2n profiler for the ESO/VLT Adaptive Optics Facility. Monthly Notices of the Royal Astronomical Society, 448, 3, 2594-2607.

Abstract:
The Adaptive Optics Facility (AOF) project envisages transforming one of the VLT units into an adaptive telescope and providing its ESO (European Southern Observatory) second generation instruments with turbulence-corrected wavefronts. For MUSE and HAWK-I this correction will be achieved through the GALACSI and GRAAL AO modules working in conjunction with a 1170 actuators deformable secondary mirror (DSM) and the new Laser

Guide Star Facility (4LGSF). Multiple wavefront sensors will enable GLAO (ground layer adaptive optics) and LTAO (laser tomography adaptive optics) capabilities, whose performance can greatly benefit from a knowledge about the stratification of the turbulence in the atmosphere. This work, totally based on end-to-end simulations, describes the validation tests conducted on a Cn2 profiler adapted for the AOF specifications. Because an absolute profile calibration is strongly dependent on a reliable knowledge of turbulence parameters r0 and L0, the tests presented here refer only to normalized output profiles. Uncertainties in the input parameters inherent to the code are tested as well as the profiler response to different turbulence distributions. It adopts a correction for the unseen turbulence, critical for the GRAAL mode, and highlights the effects of masking out parts of the corrected wavefront on the results. Simulations of data with typical turbulence profiles from Paranal were input to the profiler, showing that it is possible to identify reliably the input features for all the AOF modes.

Hiptmair R., Jerez C., Mao S. (2015) Extension by zero in discrete trace spaces: Inverse estimates. Mathematics of Computation 1-27

Abstract:

We consider lowest-order H-1/2 (divr,r)- and H-1/2(r) -conforming boundary element spaces supported on part of the boundary of a Lipschitz polyhedron. Assuming families of triangular meshes created by regular refinement, we prove that on these spaces the norms of the extension by zero operators with respect to (localized) trace norms increase poly-logarithmically with the mesh width. Our approach harnesses multilevel norm equivalences for boundary element spaces, inherited from stable multilevel splittings of finite element spaces**.**

Jerez C., Pinto J., Tournier S. (2015) Local Multiple Traces Formulation for High-Frequency Scattering Problems. Journal of Computational and Applied Mathematics 289 306-321

Abstract:

We present an efficient method to solve high-frequency scattering problems by heterogeneous penetrable objects in two dimensions. This is achieved by extending the so-called Local Multiple Traces Formulation, introduced recently by Hiptmair and Jerez-Hanckes, to purely spectral discretizations employing weighted Chebyshev polynomials. Together with regularization strategies to handle boundary integral operators singularities, matrix entries are quickly computed via the Fast Fourier Transform. The resulting Fredholm first-kind formulation is free from spurious resonances, and though ill-conditioned, it possesses built-in Calderón-type preconditioners. Numerical results obtained for different settings validate our claims and greatly motivate future research in this direction.

Karelovic P., Putz E., Cipriano A. (2015) A framework for hybrid model predictive control in mineral processing. Control Engineering Practice, 40, 1-12.

Abstract:

Model Predictive Control (MPC) is an advanced technique for process control that has seen a significant and widespread increase in its use in the process industry since its introduction. In mineral processing, in particular, several applications of conventional MPC can be found for

the individual processes of crushing, grinding, flotation, thickening, agglomeration, and smelting with varying degrees of success depending on the variables involved and the control objectives. Given the complexity of the processes normally found in mineral processing, there is also great interest in the design and development of advanced control techniques which aim to deal with situations that conventional controllers are unable to do. In this aspect, Hybrid MPC enables the representation of systems, incorporating logical variables, rules, and continuous dynamics. This paper firstly presents a framework for modeling and representation of hybrid systems, and the design and development of hybrid predictive controllers. Additionally, two application examples in mineral processing are presented. Results through simulation show that the control schemes developed under this framework exhibit a better performance when compared with conventional expert or MPC controllers, while providing a highly systematized methodology for the analysis, design, and development of hybrid MPC controllers.

Lagos, B., Cipriano, A. (2015) Performance Evaluation of a Distributed MPC Strategy Applied to the Continuous Stirred Tank Reactor. IEEE Latin America Transactions 13, 6, 1921-1926.

Abstract:
The search of more robust solutions for multiple-input multiple-output (MIMO) process control has motivated the development of complex modeling and control techniques for such systems. In this work the performance of a distributed controller (Distributed Model Predictive Control DMPC) versus a centralized solution (Model Predictive Control, MPC) are compared when faults in sensors and actuators occur. Preliminary results show that for faults in actuators the distributed solution has a better response but it requires more calculation time.

Negrete-Pincetic M., de Castro L., Pulgar-Painemal H.A. (2015) 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.

Olivares D., Lara J.D., Canizares C.A., Kazerani M. (2015) Stochastic-Predictive Energy Management System for Isolated Microgrids. IEEE Transactions on Smart Grid 6 6 2681-2693

Abstract:
This paper presents the mathematical formulation and control architecture of a stochastic-predictive energy management system for isolated microgrids. The proposed strategy addresses

uncertainty using a two-stage decision process combined with a receding horizon approach. The first stage decision variables (unit commitment) are determined using a stochastic mixed-integer linear programming formulation, whereas the second stage variables (optimal power flow) are refined using a nonlinear programming formulation. This novel approach was tested on a modified CIGRE test system under different configurations comparing the results with respect to a deterministic approach. The results show the appropriateness of the method to account for uncertainty in the power forecast.

Paschke N.K., Dössel O., Schaeffter T., Prieto C., Kolbitsch C. (2015) Comparison of Image Based and Reconstruction Based Respiratory Motion Correction for Coronary MR Angiography. Journal of Magnetic Resonance Imaging 42: 964–971. doi:10.1002/jmri.24858

Abstract:
Purpose: Respiratory motion correction has been shown to significantly reduce scan times for cardiac magnetic resonance angiography (MRA) while providing high quality images. Here, two commonly used methods, imaged based (IMC) and reconstruction based (RMC) respiratory motion correction, are compared regarding their dependency on motion estimation accuracy and final image quality. Methods: IMC and RMC are compared by estimating the motion from the same acquired data, using a non-Cartesian radial phase encoding acquisition. Simulations and in-vivo acquisitions in ten healthy volunteers are carried out. MRA images are reconstructed with IMC, RMC and a gold standard navigator-based respiratory gating (RG) approach. Achieved image qualities for these methods are compared quantitatively regarding visible vessel length and sharpness. Qualitative visual assessment is performed by two experts. Results: RMC led to significantly better image quality than IMC. RMC did not show a statistically significant difference compared to RG in terms of image quality while reducing scan times by 56%. Conclusion: RMC provides a similar image quality as the gold standard RG approach but almost halves the scan time and is independent of subjects' breathing patterns. Clinical validation of RMC is now warranted as potential alternative to RG, providing high quality MRA in a short and predictable scan time.

Pinto J.M., Arrieta C., Andia M.E., Uribe S., Ramos J., Vargas A., Irarrázaval P., Tejos C. (2015) Sensitivity analysis of geometric errors in additive manufacturing medical models. Medical Engineering & Physics, 37, 3, 328-334.

Abstract:
Additive manufacturing (AM) models are used in medical applications for surgical planning, prosthesis design and teaching. For these applications, the accuracy of the AM models is essential. Unfortunately, this accuracy is compromised due to errors introduced by each of the building steps: image acquisition, segmentation, triangulation, printing and infiltration. However, the contribution of each step to the final error remains unclear. We performed a sensitivity analysis comparing errors obtained from a reference with those obtained modifying parameters of each building step. Our analysis considered global indexes to evaluate the overall error, and local indexes to show how this error is distributed along the surface of the AM models. Our results show that the standard building process tends to overestimate the AM models, i.e. models are larger than the original structures. They also show that the triangulation resolution and the segmentation threshold are critical factors, and that the errors are

concentrated at regions with high curvatures. Errors could be reduced choosing better triangulation and printing resolutions, but there is an important need for modifying some of the standard building processes, particularly the segmentation algorithms.

Prieto C., Doneva M., Usman M., Henningsson M., Greil G., Schaeffter T. (2015) Highly efficient respiratory motion compensated free-breathing coronary mra using golden-step Cartesian acquisition. Journal of Magnetic Resonance Imaging 41 3 738-746

Abstract:
Purpose: To develop an efficient 3D affine respiratory motion compensation framework for Cartesian whole-heart coronary MR angiography. Methods: The proposed method achieves 100% scan efficiency by estimating the affine respiratory motion from the data itself and correcting the acquired data in the reconstruction process. For this, a golden-step Cartesian sampling with spiral profile ordering is performed to enable reconstruction of respiratory resolved images at any breathing position and with different respiratory window size. Affine motion parameters are estimated from image-based registration of 3D undersampled respiratory resolved images reconstructed with iterative SENSE and motion correction is performed directly in the reconstruction using a multiple-coils generalized matrix formulation method. This approach was tested on healthy volunteers and compared against a conventional diaphragmatic navigator-gated acquisition using quantitative and qualitative image quality assessment. Results: The proposed approach achieves 47 ± 12 % and 59 ± 6 % vessel sharpness for the right (RCA) and left (LAD) coronary artery respectively. Also good quality visual scores of 2.4 ± 0.74 and 2.44 ± 0.86 were observed for the RCA and LAD (scores from 0-no to 4-excellent coronary vessel delineation). Not statically significant difference (p value of 0.05) was found between the proposed method and an 8mm navigator-gated and tracked scan although scan efficiency increased from 61 ± 10% to 100%. Conclusions: We have demonstrated the feasibility of a new 3D affine respiratory motion correction technique for Cartesian whole-heart CMRA that achieves 100% scan efficiency and therefore a predictable acquisition time. This approach yields image quality comparable to that of an 8mm navigator-gated acquisition with lower scan efficiency. Further evaluation of this technique in patients is now warranted to determine its clinical use.

Putz E., Cipriano A. (2015) Hybrid model predictive control for flotation plants. Minerals Engineering, 70, 26-35.

Abstract:
Development of control strategies for large-scale processes has led to formulate novel methodologies to consider the global performance of a plant, facilitating the design, validation and evaluation of more complex control strategies. This paper describes a hybrid dynamic simulator for a flotation circuit with one production line composed by one cell and two banks in series, calibrated with industrial data. This simulator allows to represent a real plant behavior, facilitating the process of extracting input–output data. A PieceWise AutoRegresive eXogenous (PWARX) system is obtained from simulated plant by applying identification techniques for different operating conditions. A Hybrid Model Predictive Control (HMPC) methodology based on PWARX models has been developed and evaluated showing a good performance. Simulation results show that the proposed methodology is suitable for modelling the behavior

of a flotation process and its control stage by minimizing the tracking error in the final tail grade.

Ray A.M., Sitaram R., Rana M., Pasqualotto E., Buyukturkoglu K., Guan C., Ang K-G., Tejos C., Zamorano F., Aboitiz F., Birbaumer N., Ruiz S. (2015) A subject-independent pattern-based Brain-Computer Interface. Frontiers in Behavioral Neuroscience 9 269 15

Abstract:
While earlier Brain-Computer Interface (BCI) studies have mostly focused on modulating specific brain regions or signals, new developments in pattern classification of brain states are enabling real-time decoding and modulation of an entire functional network. The present study proposes a new method for real-time pattern classification and neurofeedback of brain states from electroencephalographic (EEG) signals. It involves the creation of a fused classification model based on the method of Common Spatial Patterns (CSPs) from data of several healthy individuals. The subject-independent model is then used to classify EEG data in real-time and provide feedback to new individuals. In a series of offline experiments involving training and testing of the classifier with individual data from 27 healthy subjects, a mean classification accuracy of 75.30% was achieved, demonstrating that the classification system at hand can reliably decode two types of imagery used in our experiments, i.e., happy emotional imagery and motor imagery. In a subsequent experiment it is shown that the classifier can be used to provide neurofeedback to new subjects, and that these subjects learn to "match" their brain pattern to that of the fused classification model in a few days of neurofeedback training. This finding can have important implications for future studies on neurofeedback and its clinical applications on neuropsychiatric disorders.

Ren H., Watts D. (2015) Early Warning Signals for Critical Transitions in Power Systems. Electric Power Systems Research, 124, 173-180.

Abstract:
Several episodes of sudden large scale disruptions in electrical service deeply impacted both the social stability and economic development in affected countries. The prevention of such catastrophic incidents poses huge challenges for reliability study and operational practices in power systems. Studies in other scientific fields show that, upon reaching a tipping point, complex dynamical systems can experience sudden transitions into a contrasting state. These transitions may be predicted through behavioral changes in some statistical measures of the system state. Inspired by these studies, this paper proposes an analysis of the critical transition in power systems from a long-term perspective. The evolution of the operational "stress" and its cyclical variation due to a slowly increasing demand and system expansions is simulated on a test system. The disturbances and the resulting failures under different stress levels are studied. Our analysis identifies the statistical trends known as flickering and critical slowing down in the operational and the recorded outage data along the simulation. These statistical changes can be used as early warning signals of the upcoming operational state which is more prone to a catastrophic blackout. The development of such early warning signals is the key to reaching higher levels of reliability in the energy supply infrastructure that society requires today.

Ríos M. (2015) Variable Route Expiration Time Based on a Fixed Probability of Failure for Ad-Hoc Networks Routing Applications. IEEE Latin America Transactions, 13, 1, 383-389.

Abstract:
In reactive routing algorithms on Ad-Hoc networks, one of the most important challenges is to minimize the number of route discovery processes, due to their high cost in bandwidth. This is achieved through a careful selection of the expiration time, i.e. the time each node keeps active the current route. Most implementations use system-wide random or arbitrary values for this parameter, even though the failure probability of a route depends of its size. Thus the use of a fixed expiration time is not necessarily efficient, and a variable allocation of expiration times for routes, according to their size, is proposed by introducing the VTOA (Variable Time Out Allocation) method. VTOA can be applied to any Ad-Hoc routing algorithm. In particular, an implementation of this method on the AODV algorithm is presented. The results obtained by simulation show VTOA improves the network's performance, both in terms of the routing overhead (8.5% lower) and average end-to-end delay (21.3% lower), when compared to the original AODV, while other indicators, as the packet delivery fraction, remain the same or are slightly better.

Ríos M., Marianov V., Pérez M. (2015) Locating fixed roadside units in a bus transport network for maximum communications probability Transportation Research Part C-Emerging Technologies, 53, 35-47.

Abstract:
A key issue in solving the difficult bus-bunching problem is being able to have reliable information about the location of the buses in the network. Most advanced public transport systems have buses with GPS devices, but the problem remains of how to send reliable information from the buses to the control unit, particularly when the density of buses is low, but there are high communications reliability requirements. As a solution, we study locating roadside units (RSUs) along the route. The buses, together with the RSUs, form a linear vehicular ad-hoc network (VANET). The RSUs are deployed so to maximize the probability of a vehicle communicating with an RSU in at most two hops. Previous studies on RSU location never took into account two hops, a conceptually different type of network. Rather, they consider that a vehicle is able to communicate only directly to an RSU (one hop), which is a well-known Maximum Covering Problem, in which one of the parties is always immobile, similar to a mobile phone network. Oppositely, our method solves the problem in which two of the intervening parties are mobile and communicate with each other, not possible to solve as a Maximum Covering Problem. We estimate the probability of a vehicle accessing successfully an RSU either directly or through the relay of another vehicle. This probability is later embedded in an integer programming formulation that optimizes the RSU locations for maximum communications likelihood. Numerical examples show that the connection probability is strongly dependent on the coverage ratio of the transmitters and receivers and relatively independent on the vehicle density on the network, when densities are low. Results also show that it is possible to find some cost-efficient solutions which result in a smaller number of RSUs located while assuring a connection probability of 0.9 or higher.

Romero S., Rudnick H. (2015) Stabilization fund for energy prices to promote renewable energy. IEEE Latin America Transactions, 13, 3, 687- 697.

Abstract:
The formulation of a Price Stabilization Fund to encourage the development of renewable projects is formulated. It seeks to reduce the risks associated with the volatility of the spot market prices, to facilitate access to project financing. This fund acts as a virtual trader, buying energy to developers of renewable projects, offering a fixed stabilized price in the long-term. In turn, the Fund would sell this energy in the spot market at marginal cost, assuming market risks associated with the price variability. The operation of the Fund is evaluated, seeking to determine under which operative conditions it would be viable, and to what extent it is possible to find or define operating parameters to maximize the energy supported by this instrument.

Rudnick, H. Economics of Electricity: The Market Impacts of Developments in Supply [Guest Editorial]. IEEE Power and Energy Magazine,vol.13, no.4, , July-Aug. 2015, 12-16.

Abstract:
The articles in this special section focus on new markets, resource, and government policies that are affecting the global power markets. We are facing new paradigms in the worldwide power sector. These paradigms affect every aspect of the system, including the technologies that exist today coupled with environmental factors, renewables, demand response, and regulatory concerns, among others.

Sáez D., Ávila F., Olivares D., Canizarez C.A., Marín L. (2015) Fuzzy Prediction Interval Models for Forecasting Renewable Resources and Loads in Microgrids. IEEE Transactions on Smart Grid, 6, 2, 548-556.

Abstract:
An energy management system (EMS) determines the dispatching of generation units based on an optimizer that requires the forecasting of both renewable resources and loads. The forecasting system discussed in this paper includes a representation of the uncertainties associated with renewable resources and loads. The proposed modeling generates fuzzy prediction interval models that incorporates an uncertainty representation of future predictions. The model is demonstrated using solar and wind generation and local load data from a real microgrid in Huatacondo, Chile for one-day ahead forecasts to obtain the expected values together with fuzzy prediction intervals to represent future measurement bounds with a certain coverage probability. The proposed prediction interval models would help to enable the development of robust microgrid EMS.

Saldías H., Dixon J., Morán L. (2015) Finite set model predictive control to a shunt multilevel active filter. Compel - The International Journal for Computation and Mathematics in Electrical and Electronic Engine, 34, 1, 279-300.

Abstract:
This paper is focused in the application of the predictive controller to a single-phase parallel APF composed for two H-bridges connected in series. The same methodology can be applied to a three-phase APF. In the DC buses of each H-bridge, a floating capacitor was connected,

whose voltage is regulated by the predictive controller. The controller is composed by, first, a model for the charge/discharge dynamics for each floating capacitor and a model for the output current of the APF; second, a cost function; and third, an optimization algorithm that is able to control all these variables at the same time, choosing in each sample period the best combination of firing pulses.

Sotelo J., Urbina J., Valverde I., Tejos C., Irarrázaval P., Hurtado D., Uribe S. (2015) Quantification of wall shear stress using a finite-element method in multidimensional phase-contrast MR data of the thoracic aorta. Journal of Biomechanics, 48, 10, 1.817-1.827.

Abstract:
We present a computational method for calculating the distribution of wall shear stress (WSS) in the aorta based on a velocity field obtained from two-dimensional (2D) phase-contrast magnetic resonance imaging (PC-MRI) data and a finite-element method. The WSS vector was obtained from a global least-squares stress-projection method. The method was benchmarked against the Womersley model, and the robustness was assessed by changing resolution, noise, and positioning of the vessel wall. To showcase the applicability of the method, we report the axial, circumferential and magnitude of the WSS using in-vivo data from five volunteers. Our results showed that WSS values obtained with our method were in good agreement with those obtained from the Womersley model. The results for the WSS contour means showed a systematic but decreasing bias when the pixel size was reduced. The proposed method proved to be robust to changes in noise level, and an incorrect position of the vessel wall showed large errors when the pixel size was decreased. In volunteers, the results obtained were in good agreement with those found in the literature. In summary, we have proposed a novel image-based computational method for the estimation of WSS on vessel sections with arbitrary cross-section geometry that is robust in the presence of noise and boundary misplacements.

Torres M., Arredondo T., Castillo-Pizarro P. (2015) Survey and comparative study of free simulation software for mobile robots. Robotica, 6, 9, 1-32.

Abstract:
In robotics, simulation has become an essential tool for research, education, and design purposes. Various software tools for mobile robot simulation have been developed and have reached different levels of maturity in recent years. This paper presents a general survey of mobile robot simulation tools and discusses qualitative and quantitative aspects of selection of four major simulators publicly available at no cost: Carmen, Player-Stage-Gazebo, Open Dynamics Engine, and Microsoft Robotics Developer Studio. The comparison of the simulators is aimed at establishing the range of applications for which these are best suited as well as their accuracy for certain simulation tasks. The simulators chosen for detailed comparison were selected considering their level of maturity, modularity, and popularity among engineers and researchers. The qualitative comparison included a discussion of relevant features. The quantitative analysis entailed the development of a detailed dynamical model of a mobile robot on a road with varying slope. This model was used as benchmark to compare the accuracy of each simulator. The validity of the simulated results was also contrasted against measurements obtained from experiments with a real robot. This research and analysis should be very valuable

to educators, engineers, and researchers who are always seeking adequate tools for simulating autonomous mobile robots.

Usman M., Atkinson D., Heathfield E., Greil G., Schaeffter T., Prieto C. (2015) Whole left ventricular functional assessment from two minutes free breathing multi-slice CINE acquisition. Physics in Medicine and Biology 60 7 N93-N97

Abstract:
Two major challenges in cardiovascular MRI are long scan times due to slow MR acquisition and motion artefacts due to respiratory motion. Recently, a Motion Corrected-Compressed Sensing (MC-CS) technique has been proposed for free breathing 2D dynamic cardiac MRI that addresses these challenges by simultaneously accelerating MR acquisition and correcting for any arbitrary motion in a compressed sensing reconstruction. In this work, the MC-CS framework is combined with parallel imaging for further acceleration, and is termed Motion Corrected Sparse SENSE (MC-SS). Validation of the MC-SS framework is demonstrated in eight volunteers and three patients for left ventricular functional assessment and results are compared with the breath-hold acquisitions as reference. A non-significant difference ($P > 0.05$) was observed in the volumetric functional measurements (end diastolic volume, end systolic volume, ejection fraction) and myocardial border sharpness values obtained with the proposed and gold standard methods. The proposed method achieves whole heart multi-slice coverage in 2 minutes under free breathing acquisition eliminating the time needed between breath-holds for instructions and recovery. This results in at least 2-fold speed up of the total acquisition time in comparison to the breath-hold acquisition.

Usman M., Atkinson D., Kolbitsch C., Schaeffter T., Prieto C. (2015) Manifold learning based ECG-free free-breathing cardiac CINE MRI. Journal of Magnetic Resonance Imaging 41 6 1521-1527

Abstract:
Purpose: To present and validate a manifold learning (ML)-based method that can estimate both cardiac and respiratory navigator signals from electrocardiogram (ECG)-free free-breathing cardiac magnetic resonance imaging (MRI) data to achieve self-gated retrospective CINE reconstruction.
Materials and Methods: In this work the use of the ML method is demonstrated for 2D cardiac CINE to achieve both cardiac and respiratory self-gating without the need of an external navigator or ECG signal. This is achieved by sequentially applying ML to two sets of retrospectively reconstructed real-time images with differing temporal resolutions. A 1D cardiac signal is estimated by applying ML to high temporal resolution real-time images reconstructed from the acquired data. Using the estimated cardiac signal, a 1D respiratory signal was obtained by applying the ML method to low temporal resolution images reconstructed from the same acquired data for each cardiac cycle. Data were acquired in five volunteers with a 2D golden angle radial trajectory in a balanced steady-state free precession (b-SSFP) acquisition. The accuracy of the estimated cardiac signal was calculated as the standard deviation of the temporal difference between the estimated signal and the recorded ECG. The correlation between the estimated respiratory signal and standard pencil beam navigator signal was evaluated. Gated CINE reconstructions (20 cardiac phases per cycle,

temporal resolution ~30 msec) using the estimated cardiac and respiratory signals were qualitatively compared against conventional ECG-gated breath-hold CINE acquisitions.
Results: Accurate cardiac signals were estimated with the proposed method, with an error standard deviation in comparison to ECG lower than 20 msec. Respiratory signals estimated with the proposed method achieved a mean cross-correlation of 94% with respect to standard pencil beam navigator signals. Good quality visual scores of 2.80 ± 0.45 (scores from 0, bad, to 4, excellent quality) were observed for the proposed approach in comparison with the conventional ECG-gated breath-hold images (visual score: 3.00 ± 0.71).
Conclusion: Accurate respiratory and cardiac navigator signals can be estimated using the proposed framework from the acquired data itself, resulting in retrospective self-gated CINE reconstruction with high spatial and temporal quality.

Watts D., Albornoz C., Watson A. (2015) Clean Development Mechanism (CDM) after the first commitment period: Assessment of the world′s portfolio and the role of Latin America. Renewable & Sustainable Energy Reviews, 41, 1176-1189.
Abstract:
The clean Development Mechanism (CDM) represents the main effort to help developing countries develop sustainably and developed countries to reach their emission reductions targets set under the Kyoto Protocol. With the ending of the first commitment period, there is an opportunity to assess the state of the CDM portfolio (2008–2012). This article is the first effort to evaluate the CDM portfolio throughout the first commitment period, as well as the first paper focused on Latin America׳s CDM portfolio as a whole, concentrating on renewable energy projects. Moreover, a special analysis is performed for Chile, Latin America׳s third most important CDM country (after Brazil and Mexico), 6th worldwide (after China, India, Korea, Brazil and Mexico) and first in CERs registered among the small countries, an ideal host because of its high political stability, government effectiveness, access to capital and regulatory quality. In addition, a study was performed on 180 renewable energy projects in Latin America, revealing that the additionality assessments performed under the CDM are too subjective, hindering the validation of the projects and their transparency. The main policy implication of this research is to expose the need for a radical change to the succeeding document to the Kyoto Protocol in order to reduce the inequality amongst host countries and ensure that CDM fulfills its sustainable development claim. Some of the proposed measures include establishing uniform benchmarks to be used against similar projects, a thorough validation for declared barriers, simplifying the registering process, and providing international aid for the least developed countries that have historically lacked the ability to participate in the CDM.

Watts D., Valdés M.F., Jara D., Watson A. (2015) Potential residential PV development in Chile: The effect of Net Metering and Net Billing schemes for grid-connected PV systems. Renewable & Sustainable Energy Reviews, 41, 1037–1051.
Abstract:
In recent years the global photovoltaic (PV) market has expanded rapidly due to a sharp decline in PV prices and increased attention to the importance of sustainable energy. Northern Chile has one of the highest irradiance levels in the world as well as one the highest electricity rates in Latin America. Because of these conditions, Chile is one of very few countries where several

PV projects are being developed without government subsidies and consequently, the PV industry is experiencing rapid growth. This paper reviews the opportunity to take advantage of these market conditions within the residential sector, modeling PV arrays across 10 cities in Chile. A detailed modeling of PV systems is performed to achieve an accurate analysis of energy production and electricity cost, using local resource data, optimal array orientation and inclination, and production losses. A review of how Net Metering and Net Billing affect the value of the PV production is applied and a comparison using levelized cost of electricity (LCOE) is conducted. Net Metering is found to be a better policy choice to promote PV systems than Net Billing because energy injected into the electrical network is paid at the complete retail rate. However, in developed countries this kind of policy is unlikely to be supported because of it׳s economic unfeasibility. Under a Net Billing scheme a consumer will see an advantage when energy is recorded over longer time intervals and when installing a system with smaller capacity relative to household electricity consumption. This prevents excess generation from being injected into the network which would be bought by the utility at lower prices than the retail rate. Payback periods are found to be low, between 6 years in northern areas with high retail rates and 13 years in other areas with lower radiation and retail rates.

V. PUBLICACIONES EN CONGRESOS

Arnold, D.B., Negrete-Pincetic, M., Stewart, E.M., Auslander, D.M., Callaway, D.S.(2015) Extremum Seeking control of smart inverters for VAR compensation. Power & Energy Society General Meeting, 2015 IEEE , vol., no., pp.1-5, 26-30.

Abstract:
Reactive power compensation is used by utilities to ensure customer voltages are within pre-defined tolerances and reduce system resistive losses. While much attention has been paid to model-based control algorithms for reactive power support and Volt Var Optimization (VVO), these strategies typically require relatively large communications capabilities and accurate models. In this work, a non-model-based control strategy for smart inverters is considered for VAR compensation. An Extremum Seeking control algorithm is applied to modulate the reactive power output of inverters based on real power information from the feeder substation, without an explicit feeder model. Simulation results using utility demand information confirm the ability of the control algorithm to inject VARs to minimize feeder head real power consumption. In addition, we show that the algorithm is capable of improving feeder voltage profiles and reducing reactive power supplied by the distribution substation.

Arrieta, C., Sing-Long, C., Uribe, S., Andia, M.E. Irarrazaval, P., Tejos, C. Level set segmentation with shape prior knowledge using intrinsic rotation, translation and scaling alignment. Proceedings IEEE 12th International Symposium on Biomedical Imaging (ISBI), New York, April 2015.

Abstract:
Level set-based algorithms have been extensively used for medical image segmentation. Despite their relative success, standard level set segmentations tend to fail when images are severely corrupted or in poorly defined regions. This problem has been tackled incorporating shape prior knowledge, i.e. restricting the evolving curve to a distribution of shapes pre-defined during a training process. Such shape restriction needs to incorporate invariance to translation, rotations and scaling. The common approach for this is to solve a registration problem during the curve evolution, i.e. finding optimal registration parameters. This procedure is slow and produces variable results depending on the order in which the registration parameters were optimized. To overcome this issue Cremers et al. (2006) proposed an intrinsic alignment formulation, which is a normalized coordinate system for each shape, thus avoiding the optimization step to account for the registration. Nevertheless, their proposed solution considered only scaling and translation, but not rotations which are critical for medical imaging applications. We added rotations to this intrinsic alignment, using eigenvalues and eigenvector matrices of the covariance matrix of each shape, and we incorporated them into the evolution equation, allowing us to use shape priors in complex segmentation problems. We tested our algorithm combined with a Chan-Vese functional in synthetic images and in 2D right ventricle MRI.

Jie, L., Negrete-Pincetic, M., Gupta, V. (2015) Optimal charging profiles and pricing strategies for electric vehicle charging stations. PowerTech, 2015 IEEE Eindhoven , vol., no., pp.1-6.

Abstract:
In this paper, we analyze the electric vehicle charging business by modeling the charging station and the electric vehicle customer as market players. Each player maximizes his own utility by choosing the charging profile. This problem is first considered under the condition that the charging price is exogenous, where competitive equilibrium is studied. The charging profile at the competitive equilibrium maximizes the utilities of both market players simultaneously. Furthermore, a Stackelberg scenario is considered, where the charging station as a leader is able to alter the price based on the knowledge of the customer's preference. Both equilibria are characterized in the dynamic scope over a given time horizon using Pontryagin minimum principle. Moreover, the competitive equilibrium is shown to be socially optimal. The upper bound of social optimality gap of the Stackelberg equilibrium is also provided. Numerical examples are given to illustrate the results.

Juul, F., Negrete-Pincetic, M., MacDonald, J., Callaway, D. (2015) Real-time scheduling of electric vehicles for ancillary services. Power & Energy Society General Meeting, 2015 IEEE , vol., no., pp.1-5, 26-30.

Abstract:
This work is part of a project that aims to demonstrate the concept of Vehicle-to-Grid (V2G) with an operational fleet. A fleet of electric vehicles is operated with the objective of providing regulation services to the grid. The focus of this paper is on the real-time operation of the fleet. Specifically, given an optimal trajectory for the vehicle state of charge, schemes for distributing the regulation power commands among the vehicles are tested. A scheme based on a convex optimization problem is proposed. Several numerical illustrations and simulations show the effectiveness of the scheme respect to common scheduling heuristics in terms of accuracy.

Lagos B., Karelovic P., Cipriano A. (2015). Performance evaluation of a distributed hybrid MPC strategy applied to the four-tank system. Proceedings of the 17th IFAC Symposium on System Identification, SYSID 2015, Beijing, 19-21 October 2015, 6 pages.

Abstract:
The interest in control for distributed systems has led to the development of strategies that aim to overcome issues related to high computational burden or lack of robustness. Furthermore, the search for more convenient ways of modeling MIMO systems has motivated the development of techniques for the representation and control of hybrid systems that include both continuous and discrete variables. In this article we compare the robustness of a Distributed Hybrid MPC strategy against a Centralized MPC strategy, applied to the four-tank system. Performance was evaluated by testing random failure in sensors and actuators. Results show that for medium levels of failure, the distributed strategy has a better performance, but it requires more calculation time. The methodology proposed can be used in different applications, however it does not have assured convergence properties.

Moser D., Pinto D., Cipriano A. (2015) Developing a multiagent based decision support sysrem for real time multi-risk disaster management. Proceedings of the 17th International Conference on Disaster and Emergency Management, ICDEM 2015, Prague, 23-24 March 2015, 6 pages.

Abstract:
A Disaster Management Systems (DMS) is very important for countries with multiple disasters, such as Chile. In the world (also in Chile) different disasters (earthquakes, tsunamis, volcanic eruption, fire or other natural or amn-made disasters) happen and have an effect on the population. It is also possible that two or more disasters occur at the same time. This means that a multi-risk situation must be mastered. To handle such a situation a Decision Support System (DSS) based on multiagents is a situable architecture. The most known DMSs are concerned with only a single disaster (sometimes the combination of earthquakes and tsunami) and often with a particular disaster. Nevertheless, a DSS helps for a better realtime response. Analyze the existing systems in the literature and expand them for multi-risk disasters to construct a well-organized system is the proposal of our work. The here shown work is an approach of a multi-risk system, wich needs an architecture and well defined aims. In this moment our study is a kind of case study to analyze the way we have to follow to create our proposed system in the future.

Pacheco C., Cipriano A. (2015). Design of Real Time Early Response Systems for natural disaster management based on automation and control technologies. Proceedings of the 17th International Conference on Disaster and Emergency Management, ICDEM 2015, Prague, 23-24 March 2015, 6 pages.

Abstract:
A new concept of response system is proposed for filling the gap that exists in reducing vulnerability during immediate response to natural disasters. Real Time Early Response Systems (RTERSs) incorporate real time information as feedback data for closing control loop and for generating real time situation assessment. A review of the state of the art on works that fit the concept of RTERS is presented, and it is found that they are mainly focused on manmade disasters. At the same time, in response phase of natural disaster management many works are involved in creating early warning systems, but just few efforts have been put on deciding what to do once an alarm is activated. In this context a RTERS arises as a useful tool for supporting people in their decision making process during natural disasters after an event is detected, and also as an innovative context for applying well-known automation technologies and automatic control concepts and tools.

Pacheco C., Karelovic P., Cipriano A. (2015). Comparing dynamic evacuation control strategies for emergency situations. Proceedings of the European Control Conference, ECC 2015, Linz, 17-19 July 2015, 6 pages.

Abstract:
A comparative study of dynamic evacuation control strategies for emergency situations such as fires or earthquakes is presented. Due to the changing nature of emergency situations, there is a clear need for generating dynamic evacuation plans that consider ongoing situations like hazardous areas or amount and location of evacuees. In this paper we show how automatic control can contribute to address this problem, therefore we compare open loop and closed loop

strategies, and decentralized, distributed and centralized approaches. Evacuation performance is measured through the total evacuation time in a one story building with three exits, considering different levels of hazard and congestion. Results show that real time measurements of hazard and congestion incorporate valuable information to the control system, and also that distributed control strategies seem to be more suitable for addressing the problem due to their low computational cost and good performance.

Pinto D., Castro L., Cruzat M., Barros S. Gironás J., Oberli C., Torrest M., Escauriaza C., Cipriano A. (2015). Decision Support System for a pilot Flash Flood Early Warning System in central Chile. Proceedings of the 17th International Conference on Disaster and Emergency Management, ICDEM 2015, Prague. 23-24 March 2015, 6 pages.

Abstract:
Flash floods, together with landslides, are a common natural threat for people living in mountainous regions and foothills. One way to deal with this constant menace is the use of Early Warning Systems, which have become a very important mitigation strategy for natural disasters. In this work we present our proposal for a pilot Flash Flood Early Warning System for Santiago, Chile, the first stage of a more ambitious project that in a future stage shall also include early warning of landslides. To give a context for our approach, we first analyze three existing Flash Flood Early Warning Systems, focusing on their general architectures. We then present our proposed system, with main focus on the decision support system, a system that integrates empirical models and fuzzy expert systems to achieve reliable risk estimations.

Yenes, A., Munoz, D., Pereda, J., Optimal Asymmetry for Cascaded Multilevel Converter with Cross-Connected Half-Bridges. Industrial Electronics Society, IECON 2015- 41th Annual Conference of the IEEE, vol., no., pp.,Nov. 9-12, 2015, Yokohama, Japan.

Abstract:
DC-AC conversion has been revolutionized by multilevel converters due to their high power quality, high modularity and high voltage operation with standard semiconductors. New multilevel topologies, voltage asymmetries and control techniques have been developed in the last decade to improve the performance of these power converters. This paper proposes a novelvoltage asymmetry for a three-phase cascaded multilevel converter based on cross-connected half-bridge cells. The proposed asymmetry is compared with the state-of-the-art asymmetry in the same topology and with several asymmetries and topologies as the conventional Cascaded H-Bridge (CHB), the Asymmetric Cascaded H-Bridge (ACHB) and the Neutral Point Clamped (NPC). This paper presents a comparison and analysis of voltage levels generated, the number of IGBTs and isolated voltage supplies required. Simulation results are presented for a converter of 11 kV and 4 MVA. The proposed configuration increase the number of voltage levels in three-phase loads, reducing the Total Harmonic Distortion (THD) under 1%. On the other hand, the total blocking voltage was not reduced, but the number of isolated power sources required for the proposed topology is very low in comparison with other topologies.

Sotelo, J., Urbina, J., Valverde, I., Tejos, C., Irarrázaval, P., Andia, M., Uribe, S., Hurtado, D. Cuantificación tridimensional de parámetros cardiovasculares usando elementos finitos e imagines de flujo obtenidas por resonancia magnética (4D flow). XIV Jornadas de Mecánica Computacional 2015, Concepción, Chile, 2015.
Resumen:

Sotelo, J., Urbina, J., Valverde, I., Tejos, C., Irarrazaval, P., Hurtado, D.E., Uribe, S. 3D Quantification of hemodynamics parameters of pulmonary artery and aorta using finite-element interpolations in 4D flow MR data. 18th 18th Annual SCMR Scientific Sessions, Nice, France, 2015.
Abstract:
Several hemodynamic parameters based from 3D cine PC-MRI have been proposed during the last years, including wall shear stress (WSS), oscillatory index (OSI), vorticity and helicity among others. Most of these parameters are quantified using 2D planes, and only few methods have exploited the advantage of using the 3D data. The disadvantage of using 2D planes is that it does not provide the whole distribution of the hemodynamics parameter in the entire vessel of interest. This process is therefore dependent on the user and may lead to results that have low reproducibility. We have developed a computational framework that integrates advanced image processing strategies and computational techniques based on finite element interpolations to perform a 3D quantification of hemodynamics parameters based on 3D cine PC-MRI.

Sotelo, J., Urbina, J., Valverde, I., Tejos, C., Irarrazaval, P., Hurtado, D.E., Uribe, S. 3D Quantification of vorticity and helicity from 4D flow data using finite element interpolations. Proceedings 23rd International Conference of the ISMRM, Toronto, Canada, 2015.
Abstract:
Several methods have been proposed to analyze hemodynamic parameters from 4D flow data, however the quantification of these parameters from 4D flow data is usually done in 2D planes manually located along the vessel of interest, generating a dependency on the user that may lead to results that have low reproducibility. Some reports include the analysis of the vorticity and helicity to evaluate different flow patterns from 4D flow data, but most of these studies consist on a qualitative analysis 1-3. Recently, it has been reported a quantitative method to calculate the helicity density or the relativity helicity density using 4D flow data4, however this method is also based in the calculation of 2D planes. In this work we propose a novel method that integrates advanced image processing strategies and computational techniques based on finite element interpolations to obtain a 3D quantitative map of vorticity, helicity density and relativity helicity density derived from 4D flow data sets.

Urbina, J., Sotelo, J., Montalva, C., Tejos, C., Irarrazaval, P., Andia, M.E., Valverde, I., Uribe, S. Systolic pressure gradients derived from 4D flow in a physiological healthy and aortic coarctation phantom versus cardiac catheterization. Proceedings 23rd International Conference of the ISMRM, Toronto, Canada, 2015.

Abstract:

Purpose: Aortic coarctation (AoCo) disease accounts for 4 to 6 % of all congenital heart defects with a reported prevalence of about 4 per 10,000 live births1. Peak to peak pressure gradient through the aortic coarctation is the clinical standard to determine the severity of this disease and to refer patients to surgery repair. However, such a gradient sometimes need to be revealed by the use of isoprenaline to mimic physical exercise. Pressure gradient can be measured with echocardiography, though this technique obtains over estimated pressure values. Catheterization is the gold standard method, though is an invasive technique and patient are exposed to x-rays. During the last years, 4D flow has emerged as a MRI technique capable to measure hemodynamic parameters, including pressure gradients. However, due to the long acquisition time of 4D flow data, it is difficult to evaluate the accuracy of pressure gradients derived from 4D flow data in patients under different hemodynamic conditions. The purpose of this work is to evaluate the accuracy of pressure gradients derived from 4D flow in controlled experiments using a physiological healthy and aortic coarctation phantom at rest and stress conditions

Urbina, J., Sotelo, J., Tejos, C., Irarrazaval, P., Andia, M.E., Razavi, R., Valverde, I., Uribe S. A realistic MR compatible Aortic Phantom to validate hemodynamic parameters from MRI data: aortic coarctation patient comparison using catheterization. 18th Annual SCMR Scientific Sessions, Nice, France, 2015.

Abstract:

Recently, 3D printing technologies have emerged as a very innovative technique to produce anatomical replicas. Nevertheless, vessel phantoms built up to now are simplified models, with difficulties to obtain parameters with physiological values. The aim of this work is to show and validate a MR compatible thoracic aorta system, designed to obtain hemodynamic parameters within a range comparable to healthy volunteers and patients with aortic coarctation (AoCo).

VI. OTRAS PUBLICACIONES

Nayyar, A., Negrete-Pincetic, M., Poolla, K., Varaiya, P., Duration-differentiated Energy Services with a Continuum of Loads, Control of Network Systems, IEEE Transactions on Control of Network Systems , no.99, pp.1-1.

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 like 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 equals 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.

Juan W. Dixon, "Power Electronics and Systems", Chapter 2, Multilevel Converters, IET (Institute ofEngineering and Technology), UK., pp. 43-74, Dec. 2015, ISBN 978-1-84919-826-4. (Capitulo de libro).

VI. PROYECTOS DE INVESTIGACION

Anillo (2015-2017) Magnetic resonance imaging technology for aging related diseases: brain, heart and vessels
Director Pablo Irarrázaval
Investigadores: Marcelo Andia, Cristian Tejos, Sergio Uribe, Attilio Rigotti
Monto total asignado: $450.000.000.-

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

CORFO INNOVA (2015-2016) Validar y Empaquetar Sistema de Monitorización y Analizador de Calidad de Variables para el Apoyo a la Operación Hidrometalúrgica", presentado a la Línea de Financiamiento "Validación y Empaquetamiento de Innovaciones Basadas en I+D"
Director: Aldo Cipriano
Monto asignado:$ 92.716.500.-

CORFO INNOVA (2014-2015) Empaquetamiento y transferencia del sistema de apoyo a la operación para la hidrometalurgia SAOH.
Director: Aldo Cipriano
Monto asignado: $44.750.000.-

EQM150033 Equipo de imágenes de resonancia magnética pre-clínico.
Investigador responsable: Sergio Uribe
Monto asignado: $199.664.798.-

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

FONDAP- CENTROS DE EXCELENCIA 15110017 (2013-2017) CIGIDEN: National research center for integrated natural disasters management
Investigador Principal/Director: Aldo Cipriano
Investigador asociado: Christian Oberli / Investigador asociado: Marcelo Guarini / Investigador asociado: Andrés Guesalaga
Monto asignado:$ 835.000.000 anuales (total aporte Fondap)

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

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.

FONDEF CA13I10203 (2014-2015) Construcción de un espectrógrafo astronómico de alta resolucion – FIDEOS
Investigador Responsable: Leonardo Vanzi
Monto asignado: $119.878.00

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 IDeA (2014-2015) Estudio y desarrollo de un analizador de calidad de mineral aglomerado en hidrometalurgia del cobre.
Director: Aldo Cipriano
Monto asignado: $119.999.860.-

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.-

Fondecyt Iniciación 11121166**, (2012-2015) Novel Boundary Integral Formulations and Preconditioners for Computational Modeling in Radio Astronomy and Anesthesiology.**
Investigador principal: Juan Carlos Jerez
Monto asignado: 62.923K CLP

FONDECYT 3160042 (2015 - 2018): Memristive Neural Computing & Learning Architectures (CLeArMeNu)
Investigador responsable: Angel Abusleme
Postdoctorado: Ioannis Vourkas

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

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 1141036, (2014-2018) Non-invasive 3D full-field Quantification of cardiovascular 4D flow MR images
Investigador Responsable: Sergio Uribe
Co-investigador: Cristián Tejos
Monto asignado: $200.000.000.-

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

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

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 1130265 (2013-2016) Location and routing of undesirable items
Coinvestigador: Miguel Ríos
Monto asignado:$1.000.000.- por año.

FONDECYT 1130887, (2013-2016) Topologically flexible prior shape knowledge for Level Set segmentations
Investigador principal: Cristián Tejos
Monto asignado: $60.000.000.-

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

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

GdF Suez Chile-PUC (2014-2015) Convenio para desarrollar la Optimización de Controladores para Generadores Síncronos y elementos FACTS (Flexible AC Transmission Systems) con el propósito de reducir las oscilaciones de potencia en sistemas interconectados
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:

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.-

Transmisora Eléctrica del Norte (TEN) (2014-2015) Convenio Interconexión SIC_SING Investigador Responsable: Sebastián Ríos
Monto asignado: $78.059.157.-

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.-

VRI PUC 15-2013, (2013-2015) Resonancia Magnética Funcional en combinación con Electroencefalografía. Implementación para el estudio del funcionamiento cerebral a través de un sistema Interfaz Cerebro-Computadora
Co-investigador: Cristián Tejos
Monto asignado: $10.000.000.-

PROGRAMA DE INVESTIGACIÓN ASOCIATIVA ACT 1118 (2012-2015) 2015
National Research Group in Numerical Analysis of Partial Differential Equations.
Investigador asociado: Juan Carlos Jerez
Monto asignado: 450.000K CLP