Departamento de Ingeniería Eléctrica

Informe Productividad 2019 DIE-UC

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INTRODUCCION

Durante el año 2019, el Departamento de Ingeniería Eléctrica de la Pontificia Universidad Católica de Chile, ha continuado con su labor de investigación a través de estudios publicados en revistas, tesis y el desarrollo de proyectos financiados por Fondecyt, Fondef y otras fuentes en las diferentes especialidades de la Ingeniería Eléctrica.

El presente Informe reúne lo publicado por los profesores e investigadores de nuestro Departamento en sus distintas especialidades y tiene por objetivo dar a conocer en forma más detallada el trabajo de investigación realizado durante el año 2019.

El Informe incluye los siguientes contenidos:

- Tesistas graduados del Programa de Doctorado en Ciencias de la Ingeniería.
- Tesistas graduados del Programa de Magister en Ciencias de la Ingeniería.
- Titulados de Ingeniería.
- Publicaciones en revistas ISI.
- Proyectos de investigación desarrollados.
- Profesores Visitantes.
- Actividades internas y de difusión.

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I. TESISTAS GRADUADOS DEL PROGRAMA DE DOCTORADO EN CIENCIAS DE LA INGENIERIA

Tesista: Alessandri Amenábar, Cristóbal.
Tesis: " Ferroelectric memory and architecture for Deep neural network training in resistive crossbar arrays".
Supervisor: Ángel Abusleme
Fecha de la defensa: 10/04/2019
Resumen: El uso de matrices resistivas permite reducir el costo computacional de las redes neuronales realizando multiplicaciones de manera eficiente en el dominio analógico. Uno de los principales desafíos de estas arquitecturas es la resolución limitada y la no linealidad de las memorias resistivas disponibles en la actualidad. En esta tesis, esta limitación se aborda de dos maneras: Primero, se estudian los materiales ferroeléctricos para dispositivos de memoria multinivel. En su forma policristalina, estos materiales presentan múltiples niveles de polarización no volátiles que pueden ser controlados mediante señales de voltaje. Para este propósito, se desarrolló un modelo para extraer las propiedades estadísticas de un ferroeléctrico y una simulación de Monte Carlo que puede describir y predecir su dinámica de polarización y variabilidad. En segundo lugar, se presentan mejoras en la arquitectura para entrenar modelos de redes neuronales en matrices resistivas. Se propone un esquema preciso para la actualización de parámetros en paralelo en una matriz resistiva y se estudia el mapeo de modelos de redes neuronales a hardware con pesos no negativos. Sobre la base de este análisis, se diseña un esquema de mapeo eficiente, que mitiga el efecto de la no linealidad y la resolución limitada de los elementos resistivos.

Tesista: Pérez Odeh, Rodrigo Andrés
Tesis: "Trends in portfolio optimization in a new risk-driven market era: A review and application of models for planner, investors and managers".
Supervisor: David Watts
Fecha de la defensa: 03/09/2019
Resumen: Los agentes del mercado eléctrico deben lidiar con todo tipo de riesgos: presente en los precios hasta en lo sistémico y regulatorio. El objetivo general de este trabajo es levantar los riesgos asociados a los mercados eléctricos desde la perspectiva de los diferentes agentes, así como las medidas para mitigarlos e identificar los impactos que estas medidas tienen sobre el mercado. Se presenta una revisión de las aplicaciones de la optimización de portafolio desde la perspectiva de un regulador, un inversionista y un gerente de los activos. Se analiza la diversificación espacial como una medida de integración de energía eólica, identificando los impactos en su valor de mercado ante diferentes escenarios de penetración, restricciones de transmisión y de almacenamiento dado por los embalses. Se muestra que la diversificación espacial permite mitigarla pérdida de valor de mercado ante el aumento de la penetración, lo que permite integrarlos en mayor medida al sistema eléctrico. Desde el punto de vista del inversionista, se desarrolla una metodología para evaluar los riesgos ante la incertidumbre de la transmisión y el tiempo de tramitación de los proyectos. La metodología permite identificar diferentes estrategias de inversión óptimas de acuerdo con la aversión al riesgo del inversionista.

Tesista: Surangkhana Rudkdee
Tesis: "Optical design and prototype of a high resolution near infrared spectrograph for astronomy".
Supervisor: Leonardo Vanzi
Fecha de la defensa: 04-11-2019
Resumen: Recently, the target of the exoplanet search has moved to cooler and lower mass stars. In particular, M dwarfs are attractive because they are abundant and the habitable zone is closer in. We developed TARdYS, a spectrograph to observe cool stars in the southern hemisphere, where few high-resolution near-infrared spectrographs are available. TARdYS is a dual fiberfed, white pupil Echelle spectrograph. With an image slicer, it can yield R > 60,000 in the Y band (0.843−1.117µm). In this work, I created and evaluated the optical design of the two different configurations for a cost-effective high resolution near-infrared spectrograph. This work tests less widely tested spectrograph components, including an R6 echelle, image-slicer and a semicryogenic setup. Optimization with computer-aided simulations yields excellent spectral resolution at the diffraction limit even when taking realistic manufacturing and alignment tolerances into account. I built the prototypes and determined its performance. The measured spectral resolution agrees well with the simulation. With a simple temperature control, the spectrograph is stable within ±0.1K over several hours. The remaining spectral drift is predominately caused by environmental pressure. TARdYS will later be installed at the Tokyo Atacama Observatory (TAO) 6.5 m telescope and become available to the Chilean science community.

Tesista: Silva Oelker, Gerardo Andrés
Tesis: "Thermophotovoltaic cells design improvements through numerical simulations: uncertainty quantification and geometry optimization".
Supervisor: Carlos Jeréz
Fecha de la defensa: 15/01/2019
Resumen: Esta tesis explora dos líneas de investigación basadas en simulaciones numéricas para aplicaciones en celdas termofotovoltaicas (TPV). Primero, se investiga un método numérico que permite cuantificar cambios en el desepeño de estructuras periódicas debido a perturbaciones de forma en su superficie. La segunda línea está enfocada en el estudio de diferentes estructuras como parte de emisores térmicos en sistemas TPV. En la primera parte, presentamos un modelo capaz de calcular momentos estadísticos del campo dispersado en forma determinística. El método se basa en una expansión de Taylor de la derivada de forma resultando en ecuaciones integrales que son resueltas a través del método de los momentos. Además, el método permite una aproximación no densa, reduciendo significativamente el número de incógnitas requeridas. En la segunda parte, se investiga el potencial desempeño de gratings basados en capas de tungsteno y hafnia como emisores térmicos. Se analizaron diferentes geometrías obteniendo peaks de emitancia por sobre el 98%. Además, se optimizaron dos estructuras de sencilla fabricación para los cuales se obtuvo baja sensibilidad a la dirección de radiación. Dichas estructuras poseen alta emitancia térmica para rangos de longitudes de onda que se ajustan a la respuesta óptica de celdas fotovoltaicas de InGaAs y GaSb.

Tesista: Varela Mattatall, Gabriel Enrique Marcelo
Tesis: "Undersampled q-space reconstruction methods for diffusion spectrum imaging".
Supervisor: Pablo Irarrázaval
Fecha de la defensa: 18/07/2019
Resumen: Esta tesis explora dos líneas de investigación basadas en simulaciones La resonancia magnética de difusión entrega información de la microestructura de tejidos y es una herramienta valiosa para el estudio de enfermedades neurodegenerativas. Sin embargo, el tiempo de adquisición es inviable para rutinas clínicas. Generar estrategias que permitan obtener la totalidad de esta información con el mínimo de tiempo de adquisición facilitaría su traslado a su uso clínico. Esta investigación analiza la viabilidad y aplicabilidad de reconstituir la información total a partir de adquisiciones incompletas de resonancia magnética de difusión utilizando la teoría de sensado comprimido. Para esto, se investigaron distintos métodos para reconstituir las imágenes, bases para representación eficiente de información y distribución de muestras en el espacio de difusión para obtener un óptimo entre calidad de información reconstituida y el mínimo tiempo de adquisición posible. Los resultados generales indican mejoras para el estado del arte y se entregan recomendaciones de que métodos de reconstrucción utilizar y bajo en qué condiciones. Finalmente, se registran mejoras cuantitativas en calidad de información reconstituida y reducción de varianza para ciertos índices que se obtienen a partir de las imágenes de resonancia magnética de difusión.

II. TESISTAS GRADUADOS DEL PROGRAMA DE MAGISTER ENCIENCIAS DE LA INGENIERIA

Tesista: Arancibia Pérez, Maximiliano Gabriel
Tesis: "Electric Vehicle Fleet Control for Renewable Generation Integration in Smart-Grids"
Supervisor: Matías Negrete
Fecha de la defensa: 30/08/2019
Resumen: La investigación se centra en la resolución de dos de los problemas de integración de las VRE con la red eléctrica, la predicción de energía y el control de la red eléctrica. Se estudia: la predicción de generación solar a través de la integración de información contenida en imágenes salitales y predicciones del estado de la atmósfera, los datos se mezclan a través de un proceso estocástico de retorno a la media. Por otro lado se investiga la modelación matemática y control de una pequeña red eléctrica, implementando un simulador que cuenta con demanda energética variable y auto eléctricos (EV) con viajes programados. También se desarrolla una arquitectura de control, esta toma cuenta objetivos económicos, de regulación y además calidad servicio al cliente para administrar la carga y descarga de los EV. Se investiga el algoritmo DDPG del área de deep reinforcement learning, para afrontar la incertidumbre en las variables difíciles de integrar en los controladores clásicos. Se aplica para el caso de variabilidad en el uso de la batería subiendo de un 76.3% a un 97% el cumplimiento al usuario.

Tesista: Bernal Soto, Rodrigo Cristóbal
Tesis: "Management of EV Charging Stations under Advance Reservations Schemes in Electricity Markets"
Supervisor: Daniel Olivares
Fecha de la defensa: 05/12/2019
Resumen: Los vehículos eléctricos ya han sobrepasado el umbral de más de 3 millones de unidades en el 2017, esto tiene una directa implicancia en la importancia que las estaciones de carga comienzan a tener para cargarlos mientras se encuentran fuera del hogar. Adicionalmente, y tomando en cuenta la inherente flexibilidad que el proceso de carga posee, las estaciones de carga pueden proveer servicios a la red, tales como regulación de frecuencia y tensión. No obstante, dado que para lograr una carga total usando la tecnología disponible puede tomar un mínimo de ~30 minutos, los conductores pueden verse enfrentados a tiempos de espera, filas e incertidumbre sobre la disponibilidad de estaciones de carga. Conforme a lo anterior, este trabajo presenta un modelo para determinar la gestión óptima de la estación de carga a través del uso de esquemas de reserva. En este modelo, se asume que la estación de carga puede participar en el mercado de energía y regulación, además de proveer servicios de carga. Por otra parte, los usuarios de vehículos eléctricos son modelados a través de modelos de decisión del tipo "Satisficing" simple y estocástico. Las estrategias de gestión son caracterizadas por tarifas de carga y reservas, y su impacto es analizado en términos del perfil de carga y bienestar de los usuarios.

Tesista: Della *Maggiora* Valdés, Gabriel Eugenio
Tesis: "DeepSPIO: Super Paramagnetic Iron Oxide particle quantification using Deep Learning in Magnetic Resonance Imaging"
Supervisor: Pablo Irarrázaval

Fecha de la defensa: 18/11/2019

Resumen: La susceptibilidad de partículas de óxido de hierro súper paramagnético (SPIO) las convierte en un agente de contraste útil para diferentes propósitos en la resonancia magnética. La cuantificación de estas partículas en MRI se ha basado principalmente en métodos de relaxometría dentro de una región de interés o en modelos que tienen en cuenta las inhomogenidades producidas por las partículas. En este estudio presentamos un método novedoso de aprendizaje profundo para cuantificarlas a partir de una nueva secuencia de líneas de visualización en la que la información del mapa de campo está codificada en la geometría de la imagen. La novedad de la red neuronal propuesta es que utiliza bloques residuales como el cuello de botella y múltiples decodificadores para mejorar la convergencia de la red. Cada decodificador predice una parte diferente de una descomposición wavelet del mapa de concentraciones. Esta descomposición permite una convergencia mucho más rápida y también mejora nuestras predicciones de mapas. Probamos nuestra técnica de reconstrucción de concentración SPIO en simulaciones realizadas en imágenes de resonancia magnética utilizando el conjunto de datos IXI. Además, construimos 5 fantomas utilizando un cilindro de plástico que contiene agar con una distribución SPIO con diferentes concentraciones. Para ambos conjuntos de datos, el modelo pudo cuantificar con precisión la distribución de particulas.

Tesista: Fierro Piccardo, María Ignacia Belén.
Tesis: "Fast Calderón Preconditioning for Helmholtz Boundary Integral Equations"
Supervisor: Carlos Jeréz
Fecha de la defensa: 15/04/2019

Resumen: El uso de precondicionadores multiplicativos de Calderón es una manera efectiva de mejorar el número de condición de ecuaciones integrales de frontera de primer tipo, garantizando cotas para el número de condición, independientes de la discretización usada en el mallado. Sin embargo, al aplicar el Método de Elementos de Frontera de tipo Galerkin, el rendimiento en términos computacionales de estos precondicionadores empeora, a medida que la malla es refinada. Esto se debe al uso de un refinamiento baricéntrico de la malla, requerido en la construcción de funciones bases duales, que garantizan la estabilidad discreta de las matrices que surgen de los productos L2 de las funciones base (matrices de Gram). Basándonos en reglas de cuadratura de menor precisión sobre celdas duales y el uso de compresiones mediante matrices jerárquicas) proponemos una familia de precondicionadores de Calderón fast, que significativamente reducen sus tiempos de ensamblaje, en comparación a las versiones estándar de precondicionadores de Calderón para los operadores integrales de frontera tridimensionales de Helmholtz, weakly y hyper-singular. Una serie de experimentos numéricos validan nuestras afirmaciones y apuntan hacia mejoras futuras.

Tesista: Herrera Castro, Tomás Arturo
Tesis: "Embedded networking using Thread: Devices, Operating Systems and IoT Programming"
Supervisor: Felipe Núñez
Fecha de la defensa: 11/12/2019

Resumen: Desde su concepción, IEEE802.15.4 fue diseñado para soluciones pequeñas, de bajo consumo y bajo ancho de banda que podrían ser utilizados por una alta gama de dispositivos. Debido a sus características, actualmente se utiliza como base de muchos protocolos IoT, entre los que destaca Thread. Thread es un protocolo de comunicación inalámbrico que destaca sobre el resto de sus antecesores por permitir conexiones IPv6 de manera nativa, de

esta manera, los dispositivos Thread tienen la capacidad de ser parte de la red global IP, con todas las ventajas que aquello significa. Un dispositivo en particular, el Border Router, es un dispositivo que actúa como puerta de enlace, a nivel capa física y de enlace. De esta manera, dispositivos Thread que utilizan IEEE802.15.4 pueden comunicarse transparentemente a nivel de capa de red y capas superiores. Actualmente, el Border Router se ha implementado utilizando una arquitectura que utiliza un Network Co-Processor (NCP). Los autores estiman que esta arquitectura tiene varias desventajas, por lo cual, se diseña, implementa y prueba una arquitectura nueva y alternativa, la cual se contrasta con la arquitectura que utiliza un NCP. Como caso de estudio, una aplicación de monitoreo estructural que utiliza el Border Router es diseñada. En esta aplicación los dispositivos se sincronizan en tiempo e interactúan con un servidor utilizando datagramas de usuario (UDP) e IPv6. Esta aplicación se diseñó para estimar parámetros de modelos estructurales en mente. Los resultados muestran que el Border Router es superior en cuanto a latencia con una pequeña alza en la tasa de pérdida de paquetes, sin embargo, con más trabajo el Border Router no-NCP tiene el potencial de ser muy superior. En la aplicación de monitoreo estructural, se logra una sincronización en el rango de los micro-segundos al medir con osciloscopio la sincronización, sin embargo, en la práctica diferencias temporales en las señales de aceleración en torno a los milisegundos (1ms a 10ms) fueron detectadas.

Tesista: Ibañez Reyes, María de Los Angeles
Tesis: "Daily and seasonal variation of the surface temperature lapse rate and 0°C isotherm in the central chilean andes mountains".
Supervisor: Christian Oberli

Fecha de la defensa: 20/08/2019

Resumen: Cuantificar la relación que existe entre la altitud y la temperatura es fundamental para entender y modelar los fenómenos hidrometeorológicos que ocurren en zonas altas y montañosas. Una buena estimación del gradiente de temperatura (STLR, por sus siglas en inglés) y de la isoterma 0 °C es fundamental para la modelación hidrológica de las cuencas montañosas. A pesar de que estas cambian temporal como espacialmente típicamente en las modelaciones se asume constante. Esto, puede generar errores en las modelaciones hidrológicas, en la evaluación y manejo de riesgo de crecidas rápidas y aluviones entre otros. En esta tesis se estudia y caracteriza empíricamente la dinámica temporal del STLR y de la isoterma 0 °C en la Cordilla de los Andes en Chile Central. Para ello se utilizó datos temperatura de una densa red de sensores medidos cada 10 minutos, en una pequeña cuenca precordillerana (entre los 700 y 3200 m), durante dos años. Los valores obtenidos son comparados con los resultados calculados con datos públicos monitoreados fuera de la cuenca (ex situ). De las mediciones en la cuenca (in situ) encontramos variaciones significativas del STLR, tanto mensuales, diarias como horarias. Durante los eventos de precipitación los valores de STLR tienden a ser más constantes y menores, independiente de la estación del año. Más aún, para aquellos eventos donde el promedio de la isoterma 0 °C es mayor a los 3.000 m (i.e. eventos cálidos) el STLR promedio es -4.6°C/km, 1.4°C/km mayor que para los eventos nos cálidos. La estimación de la isoterma 0°C usando fuentes de datos ex situ son extremadamente sensibles a que haya una estación instaladas en altas elevaciones y a los lapsos de tiempo medidos. Finalmente, el STLR estándar de -6.5°C/km no es representativo de las condiciones in situ, especialmente durante los eventos cálidos, los cuales causan los eventos de crecidas rápidas en la zona.

Tesista: Labarca Figueroa, Ignacio Javier
Tesis: "Convolution Quadrature methods for Time Domain acoustic wave propagation in Layered media and Composite materials".
Supervisor: Carlos Jeréz
Fecha de la defensa: 10/10/2019
Resumen: Se presenta un esquema computacional novedoso para resolver el problema de scattering acústico en dos situaciones particulares, usando métodos de Cuadratura de Convolución (CQ, por sus siglas en inglés) multipaso y multietapa para una discretización en el dominio temporal. Primero, se estudian problemas en dominios por capas en dos dimensiones, es decir, scattering en interfaces penetrables y no acotadas. La metodología propuesta se basa en el método de Función de Green con Ventana (WGF), el cual reduce una ecuación integral de frontera de segundo tipo a una interfaz acotada, e introduce errores que decaen de manera super algebraica a medida que el tamaño de la ventana aumenta. La ecuación integral se resuelve mediante un método de Nyström de alto orden basado en la regla de cuadratura de Alpert. Varios ejemplos numéricos, incluyendo la propagación en guías de ondas, demuestran los alcances de la metodología propuesta. El segundo problema estudiado es el de scattering en dos dimensiones sobre materialescompuestos, es decir, obstáculos penetrables donde se pueden encontrar triples puntos. Seacude a una formulación de Múltiples Trazas, discretizada usando un método de Galerkin espectral y polinomios de Chebyshev de segundo tipo. Aún cuando la convergencia espectral no es esperada debido a la presencia de dominios Lipschitz, el método sigue siendo una opción de alto orden para resolver la ecuación integral proveniente de la formulación de múltiples trazas, entregando un esquema eficiente junto al método de cuadratura de convolución. Ejemplos numéricos con distintas configuraciones de geometrías y parámetros físicos son mostrados.

Tesista: Langarica Chavira, Saúl Alberto
Tesis: "Design and implementation of an Industrial Internet of Things platform for intelligent supervision and control of industrial processes".
Supervisor: Felipe Núñez
Fecha de la defensa: 09/08/2019
Resumen: En la era de la digitalización en que estamos viviendo hoy en día, el Internet Industrial de las Cosas (IIoT por sus siglas en inglés) ha llegado a revolucionar la industria, al grado de que los expertos ya están hablando de una cuarta revolución industrial. IIoT ha permitido la convergencia entre las tecnologías de operación con las tecnologías de la información en la industria, problema que se ha tratado de resolver muchas veces en el pasado pero sin éxito hasta ahora. Este problema consiste en conectar los equipos de campo (normalmente aislados o conectados solo a través redes locales) a internet, y con esto darles capacidades de cómputo más elevadas. Por otro lado, esto permitiría darle a los computadores la capacidad de interactuar con el mundo exterior a través de los equipos decampo en tiempo real. Desde el punto de vista del control de procesos, esto podría abrir muchas posibilidades, permitiendo que se combinase la teoría de control, ya madura y probada muchas veces en la práctica, con el nuevo mundo del aprendizaje de máquina, para crear aplicaciones innovadoras que puedan ser implementadas en ambientes industriales reales. Por otro lado, desde un punto de vista económico, este nuevo paradigma tecnológico puede llevar a mejoras tanto en calidad como en la eficiencia de los procesos, lo cual se traduce en mayores ganancias para las compañías que adopten dicha tecnología. En el caso particular de Chile, la

minería es uno de los sectores industriales que podría ser más grandemente beneficiado si se adoptasen las tecnologías de IIoT en sus procesos. Esto es especialmente cierto ahora que sus costos han subido, el grado de los minerales ha bajado y la productividad en las distintas faenas ha empezado a disminuir por diferentes razones. En esta tesis se desarrollaron dos aplicaciones para minería basadas en IioT, una aplicación de laboratorio y una aplicación real. Tras las pruebas y el análisis de los resultados, que son realmente prometedores, se ha llegado a la conclusión de que la implementación de este tipo de aplicaciones no tan solo es posible para la industria minera Chilena, sino que es un paso necesario para revertir la panorama adverso que se avecina para este importante sector de nuestro país.

Tesista: Piña Nazal, Altamiro Mohsen
Tesis: "Simulación de agentes aplicado al estudio de ejercicio de poder de mercado en el sistema eléctrico".
Supervisor: Matías Negrete
Fecha de la defensa: 21/08/2019
Resumen: La alta complejidad en el diseño de los mercados que gobiernan los Sistemas Eléctricos de Potencia están sujetos a manipulación de precios por parte de los agentes participantes debido al comportamiento estratégico de estos que es difícil de monitorear por las autoridades. En la práctica se utilizan índices de concentración de mercado, sin embargo, estos solo dan cuenta del potencial para ejercer comportamiento estratégico y no permiten detectarlo. En este trabajo se propone un modelo de optimización que permite representar las complejidades del mercado eléctrico, con el cual se realizan simulaciones basadas en agentes que representan las decisiones estratégicas de estos bajo un ambiente de competencia. De esta forma, es posible analizar cuáles son las condiciones del Sistema Eléctrico de Potencia que permiten a los agentes manipular las condiciones del mercado para su propio beneficio. El modelo propuesto es un programa matemático bi-nivel, que puede ser reformulado como un programa cuadrático-entero mixto (MIQP).

Tesista: Rodríguez Araya, Rafael Ignacio
Tesis: "Flexibility or Information: What is the value of the Aggregator?".
Supervisor: Matías Negrete
Fecha de la defensa: 23/08/2019
Resumen: Los agregadores de demanda tienen un rol clave en los futuros sistemas de energía. En específico, los agregadores pueden falicitar el uso de la flexibilidad de la demanda. Esta tesis se centra en entender cuál es el valor del agregador en términos de agregación de flexibilidad y agregación de información. Se utilizan diversas formulaciones de teoría de juegos para modelar las interacciones entre la comercializadora, el agregador y los consumidores, con diferentes niveles de información. Se propone un juego potencial para obtener el equilibrio de Nash del juego no-cooperativo con información completa y se analiza la dinámica del sistema de consumidores usando el método de expectativas adaptativas para el escenario de información incompleta. Se encuentran diversas ideas claves con respecto al agregador:
-El valor del agregador proviene principalmente por la información y no por la flexibilidad. -Consumidores flexibles podrían aumentar el costo del sistema en escenarios con información incompleta. -Los esquemas de respuesta de demanda basados solo en la señal de precio podrían no aprovechar la flexibilidad del lado de la demanda.

Tesista: Salgado Bravo, Marcelo Alejandro
Tesis: "Home Energy Management System for Demand Aggregators in Electricity".
Supervisor: Matías Negrete
Fecha de la defensa: 22/08/2019
Resumen: Se propone una nueva plataforma de Gestión Local de la Energía (Home Energy Manamegent System - HEMS) para el seguimiento de trayectorias de demanda recibidas desde un agente externo tales como un Demand Side Response (DSR) Aggregator o Load Service Entities (LSEs). El modelo HEMS presenta una primera etapa del problema, que consiste en el agendamiento de las cargas para un horizonte de 24 horas por medio de un modelo simplificado de Day-Ahead, formulación que minimiza las desviaciones de las trayectorias. Por otro lado, la segunda etapa del modelo se enfoca en minimizar los peaks de demanda y los valores por sobre la demanda esperada para un horizonte de evaluación de 2 horas, considerando un time-step de 4 minutos para agendar un conjunto limitado de cargas acorde a los resultados obtenidos por la primera etapa del modelo. Este modelo fue construido para ser resuelto por procesadores de baja potencia computacional, usando ordenadores de placa reducida (Single-Board Computers - SBC) como una prueba de concepto. Los resultados de las simulaciones muestran la efectividad del algoritmo propuesto para seguir trayectorias considerando diferentes conjuntos de cargas y condiciones de operación. En particular y bajo los casos de estudio realizados, el modelo HEMS presenta desviaciones en la demanda para el 3.2% de los casos en la primera etapa del problema y un 12% para la segunda etapa. Los resultados muestran que el modelo HEMS propuesto puede agendar las cargas disponibles y responder a los requerimientos de un DSR Aggregator con un tiempo de resolución limitado para diferentes sistemas y procesadores ARM, demostrando que puede manejar un alto número de cargas interrumpibles, ininterrumpibles y desplazables en el tiempo.

Tesista: Tapia Sandoval, Tomás Felipe
Tesis: "Robust Optimization for Wildfire Response Analysis in Highly Renewable Power Systems".
Supervisor: Alvaro Lorca
Fecha de la defensa: 13/09/2019
Resumen: Los incendios pueden ser una gran amenaza para el funcionamiento normal de los sistemas de potencia en muchas partes del mundo. Chile, California y Australia han presentado ejemplos recientes en los que los incendios han provocado importantes cortes en el suministro de energía. Además, a medida que los sistemas de energía se mueven hacia una integración significativa de fuentes de energía renovables variables como la eólica y la solar, la gestión exitosa de los impactos de los incendios en la operación de los sistemas de energía puede ser aún más difícil debido a la incertidumbre conjunta en la evolución de un incendio dado y las inyecciones de energía renovable. Motivado por esto, el documento de tesis presenta un enfoque de optimización robusto para analizar el funcionamiento del sistema de energía bajo incendios extremos. El atributo clave de este modelo es incorporar el dinamismo del evento crítico en la selección de la falla de los peores k componentes del conjunto de elementos alcanzados por el fuego, con la realización de las peores trayectorias de energía renovable durante la operación bajo contingencia. El modelo permite cuantificar el impacto en la operación del sistema para un conjunto de topologías de tipo, determinado por el operador del sistema, a través de medidas de evaluación de riesgos en la minimización de los costos operativos y la energía no suministrada. El

modelo se prueba ampliamente utilizando el CVaR como una métrica de riesgo en una representación de 65 barras del sistema eléctrico nacional chileno en el horizonte de un día en operación bajo diferentes escenarios de incendios extremos.

Tesista: Villalobos Gutiérrez, Cristian Alberto
Tesis: " Short-Term Pricing Schemes Assessment for Power System Flexibility".
Supervisor: Matías Negrete
Fecha de la defensa:
14/06/2019
Resumen: El gran crecimiento en la integración de fuentes de energía renovable variable ha generado una serie de desafíos en la operación de los sistemas eléctricos. La flexibilidad se ha convertido en un atributo indispensable para permitir que el sistema pueda reaccionar a los cambios en los niveles de generación o demanda. En este contexto, es fundamental que las señales de mercado en el corto y largo plazo capturen las características de flexibilidad para alinear los incentivos de los agentes con los requisitos sistémicos de flexibilidad. A través de este trabajo, se estudian diferentes esquemas de precios para mercados de corto plazo, considerando relajaciones del problema de comisionamiento que consideren las características de flexibilidad operacional que cada unidad puede entregar. Las simulaciones realizadas muestran las ventajas que poseen los esquemas propuestos en comparación con los esquemas de mercado convencionales, tanto en términos de los incentivos entregados al sistema, la recuperación de costos por parte de las unidades y del aprovechamiento de los recursos renovables disponibles. Además, los resultados respaldan la necesidad de incorporar esquemas alternativos de mercado a largo plazo, capaces de recompensar la capacidad de proporcionar flexibilidad al sistema.

III. TITULADOS DE INGENIERIA ELECTRICA

TITULADOS DE INGENIERIA ELECTRICA

Ingeniero Civil Electricista	Ingeniero Civil de Industrias , Diploma en Ingeniería Eléctrica
Simón Andrés Aguilera Donoso	Francisco José Aguirre Cambiaso
Javier Augusto Arenas Polanco	Daniel esteban Araya Carvajal
Luis Aros Illanes	Matías Nicolás Bustos Castro
Juan José Enrique Auda Carrasco	Danae Rosario Constanza Vabezas Cruz
Carlos Andrés Castillo Passi *	Fernando Jesús Castillo Arce
Tomás Joaquín Cruz Bull	John Esteban Collins Silva
Rodrigo Hernán Cuzmar Leiva	José Nicolás Correa Fernández
Pablo Díaz Titelman *	Sebastián Emilio De Vidts Lobo*
Nicolás Domínguez Celis	Martín René Delanghe Silva
José Antonio Eyzaguirre Domínguez	Gregorio Donoso Rasmussen
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César Emilio Olivera De La Calzada	Camila José Lozano Ortíz
Ariel Esteban Seisdedos Alvarado	Camilo Leonardo Magnere Zumarán
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	Martín Ramírez Rodríguez
	Rafael Ignacio Rodríguez Araya *
	Andrea Camila Rojas Rozas
	Aldo Maximiliano Saavedra Adasme
	Alex Scholl De Amesti
	Tomás Felipe Tapia Sandoval *
	Vicente Vildósola Santa cruz
	Gabriel Matías Yuseff Campusano

***Además recibieron el grado de Magister en Ciencias de la Ingeniería**

IV. PUBLICACIONES EN REVISTAS ISI

ANGEL ABUSLEME

Gomez J., Vourkas I., Abusleme A., Rodríguez A., Martin-Martinez J., Nafria M., Rubio A. (2019)
EXPLORING THE "RESISTANCE CHANGE PER ENERGY UNIT" AS UNIVERSAL PERFORMANCE PARAMETER FOR RESISTIVE SWITCHING DEVICES
Revista: Solid-State Electronics, Volume 165, March 2020
Abstract: Resistive switching (RS) device (memristor) technology is continuously maturing towards industrial establishment. There are RS devices that demonstrate an "incremental" (analog) switching behavior, whereas others change their state in a binary form. The final achieved resistance is generally a function of the applied pulse characteristics, i.e. amplitude and duration. However, variability —both from device to device but also from cycle to cycle— and the stochastic nature of internal RS phenomena, still hold back any universal tuning approach based solely on these two magnitudes, making also difficult the qualitative comparison between devices with different material compounds owing to the required SET/RESET voltages being dependent on the biasing conditions. In this work we demonstrate experimentally using commercial RS devices from Knowm Inc. that the switching energy is very insensitive to the biasing conditions. We explored experimentally the SET-RESET behavior of bipolar RS devices from the energy point of view. We figured out the quantitative effect of the injected energy to the resistive state of the devices, and proposed an analytical model to explain our observations in the energy consumed by the device during the switching process. Our results lay the foundations for the definition of "resistance change per energy unit" as a performance parameter for this emerging device technology.

Hurtado D.E., Abusleme A., Chávez J. (2019)
NON-INVASIVE CONTINUOUS RESPIRATORY MONITORING USING TEMPERATURE-BASED SENSORS
Revista: Journal of Clinical Monitoring and Computing, 34.
Abstract: Respiratory rate (RR) is a key vital sign that has been traditionally employed in the clinical assessment of patients and in the prevention of respiratory compromise. Despite its relevance, current practice for monitoring RR in non-intubated patients strongly relies on visual counting, which delivers an intermittent and error-prone assessment of the respiratory status. Here, we present a novel non-invasive respiratory monitor that continuously measures the RR in human subjects. The respiratory activity of the user is inferred by sensing the thermal transfer between the breathing airflow and a temperature sensor placed between the nose and the mouth. The performance of the respiratory monitor is assessed through respiratory experiments performed on healthy subjects. Under spontaneous breathing, the mean RR difference between our respiratory monitor and visual counting was 0.4 breaths per minute (BPM), with a 95% confidence interval equal to [− 0.5, 1.3] BPM. The robustness of the respiratory sensor to the position is assessed by studying the signal-to-noise ratio in different locations on the upper lip, displaying a markedly better performance than traditional thermal sensors used for respiratory airflow measurements.

H. Abramowicz, A. Abusleme, K. Afanaciev. Et al. (2019)
PERFORMANCE AND MOLIÈRE RADIUS MEASUREMENTS USING A COMPACT PROTOTYPE OF LUMICAL IN AN ELECTRON TEST BEAM
Revista: European Physical Journal, V79 N°579.
Abstract: A new design of a detector plane of sub-millimetre thickness for an electromagnetic sampling calorimeter is presented. It is intended to be used in the luminometers LumiCal and BeamCal in future linear e + e − collider experiments. The detector planes were produced utilising novel connectivity scheme technologies. They were installed in a compact prototype of the calorimeter and tested at DESY with an electron beam of energy 1–5 GeV. The performance of a prototype of a compact LumiCal comprising eight detector planes was studied. The effective Molière radius at 5 GeV was determined to be (8.1 ± 0.1 (stat) ± 0.3 (syst)) mm, a value well reproduced by the Monte Carlo

(MC) simulation (8.4 ± 0.1) mm. The dependence of the effective Molière radius on the electron energy in the range 1–5 GeV was also studied. Good agreement was obtained between data and MC simulation.

Alessandri C., Pandey P., Abusleme A., Seabaugh A. (2019)
MONTE CARLO SIMULATION OF SWITCHING DYNAMICS IN POLYCRYSTALLINE FERROELECTRICS CAPACITORS
Revista: IEEE Transactions on Electron Devices, Volume 66 Issue 8
Abstract: Ferroelectric (FE) materials are being studied for a variety of applications in memory, logic, and neuromorphic computing, for which predictive models of FE polarization are essential. In this paper, we present a Monte Carlo simulation framework capable of predicting the dynamic, history-dependent response of an FE under arbitrary input waveforms. The simulation is developed by generalizing the physics-based nucleation-limited switching model for polarization reversal in a polycrystalline FE. Measured polarization reversal data from fabricated FE Hf0.5Zr0.5O2 capacitors are used to extract the statistical distribution of FE grains. After parameter extraction, the model is able to predict the dynamics of the FE capacitor without further calibration. Finally, the model is applied to characterize the dynamic response of FE-dielectric bilayer structures and quantify the reduction in memory window due to device variability.

Gomez J., Vourkas I. Abusleme A., Sirakoulis G., Rubio. (2019)
VOLTAGE DIVIDER FOR SELF-LIMITED ANALOG STATE PROGRAMING OF MEMRISTORS
Revista: IEEE Transactions on Circuits and Systems I-Regular Papers, Volume 67 Issue 4
Abstract: Resistive switching devices -memristors - present a tunable, incremental switching behavior. Tuning their state accurately, repeatedly and in a wide range, makes memristors well-suited for multi-level (ML) resistive memory cells and analog computing applications. In this brief, the tuning approach based on a memristor-resistor voltage divider (VD) is validated here experimentally using commercial memristors from Knowm Inc. and a custom circuit. Rapid and controllable multi-state SET tuning is shown with an appreciable range of different resistance values obtained as a function of the amplitude of the applied voltage pulse. The efficiency of the VD is finally compared against an adaptive pulse-based tuning protocol, in terms of circuit overhead, tuning precision, tuning time, and energy consumption, qualifying as a simple hardware solution for fast, reliable, and energy-efficient ML resistance tuning.

Gomez J., Vourkas I., Abusleme A. (2019)
EXPLORING MEMRISTOR MULTI-LEVEL TUNING DEPENDENCIES ON THE APPLIED PULSE PROPERTIES VIA A LOW COST INSTRUMENTATION SETUP
Revista: IEEE Access, Volume 7
Abstract: Deeper understanding of memristive behavior is the only safe way towards maximum exploitation of the favorable properties and the analog nature of this new device technology in innovative applications. This can be achieved through experimental hands-on experience with real devices. However, lab experiments with memristors are a challenging step, especially for the uninitiated. In this direction, this paper presents some important considerations to carry out reliable measurements using an experimental setup composed of off-the-shelf components and an affordable data acquisition system. We specifically show how a transimpedance amplifier can be used to protect the memristor from damage via current compliance limiting, and allow full control over the voltage drop on its terminals. Using the proposed setup, a set of key experiments were carried out on commercial memristors from Knowm Inc., revealing fundamental dependencies of memristor state-tuning properties on the characteristics of the applied pulses and the initial conditions of the devices.

ALDO CIPRIANO

Langlois J.I. and Cipriano A. (2019)
DYNAMIC MODELING AND SIMULATION OF TAILING THICKENER UNITS FOR THE DEVELOPMENT OF CONTROL STRATEGIES.
Revista: Minerals Engineering V.131
Abstract: The purpose of this paper is to extend existing mathematical models of tailings rheology and sedimentation to form a complete dynamic simulator. It is complete in the sense that it includes all important rheological variables for the development of multivariable control strategies and can be integrated with other stages of tailings management systems. This work extends a one-dimensional model for the dynamics of a flocculated suspension in a clarifier-thickener to include the discharge yield stress and particle size distribution in a manner that is computationally tractable. The paper also extends a static yield stress model to include the effect of particle size distribution, in a manner that is consistent with previous empirical and theoretical evidence. The dynamic simulator is validated through the simulation of a Proportional-Integral control strategy and proves to be a useful and flexible tool for the development of control strategies.

PALO IRARRÁZAVAL

Rivera K., Salas-Pérez F., Evheverría G., Urquiaga I., Dicenta S., Pérez D., de la Cerda P., González L., Andía M. E., Uribe S., Tejos C., Martínez G., Busso D., Irarrázaval P., Rigotti A. (2019)
RED WINE GRAPE POMACE ATTENUATES ATHEROSCLEROSIS AND MYOCARDIAL DAMAGE AND INCREASES SURVIVAL IN ASSOCIATION WITH IMPROVED PLASMA ANTIOXIDANT ACTIVITY IN A MURINE MODEL OF LETHAL ISCHEMIC HEART DISEASE
Revista: Nutrients V.11 N°9
Abstract: A healthy dietary pattern and high quality nutrient intake reduce atherosclerotic cardiovascular disease risk. Red wine grape pomace (RWGP)—a rich natural source of dietary fiber and antioxidants—appears to be a potential functional food ingredient. The impact of a dietary supplementation with RWGP flour was evaluated in atherogenic diet-fed SR-B1 KO/ApoER61h/h mice, a model of lethal ischemic heart disease. SR-B1 KO/ApoER61h/h mice were fed with atherogenic (high fat, cholesterol, and cholic acid, HFC) diet supplemented with: (a) 20% chow (HFC-Control), (b) 20% RWGP flour (HFC-RWGP), or (c) 10% chow/10% oat fiber (HFC-Fiber); and survival time was evaluated. In addition, SR-B1 KO/ApoER61h/h mice were fed for 7 or 14 days with HFC-Control or HFC-RWGP diets and plasma lipid levels, inflammation, oxidative damage, and antioxidant activity were measured. Atherosclerosis and myocardial damage were assessed by histology and magnetic resonance imaging, respectively. Supplementation with RWGP reduced premature death, changed TNF-α and IL-10 levels, and increased plasma antioxidant activity. Moreover, decreased atheromatous aortic and brachiocephalic plaque sizes and attenuated myocardial infarction and dysfunction were also observed. These results suggest that RWGP flour intake may be used as a non-pharmacological therapeutic approach, contributing to decreased progression of atherosclerosis, reduced coronary heart disease, and improved cardiovascular outcomes.

Varela G., Koch A., Stirnberg R., Chabert S., Uribe S., Tejos C., Stocker T., Irarrazaval P. (2019)
COMPARISON OF Q-SPACE RECONSTRUCTIONS METHODS FOR UNDERSAMPLED DIFFUSION SPECTRUM IMAGING DATA.
Revista: Magnetic Resonance in Medical Sciences, Volumen 19, Número 2
Abstract: Purpose: To compare different q-space reconstruction methods for undersampled diffusion spectrum imaging data.Materials and Methods: We compared the quality of three methods: Mean Apparent Propagator (MAP); Compressed Sensing using Identity (CSI) and Compressed Sensing using Dictionary (CSD) with simulated data and in vivo acquisitions. We used retrospective undersampling so that the fully sampled reconstruction could be used as ground truth. We used the normalized mean squared error (NMSE) and the Pearson's correlation coefficient as reconstruction quality indices. Additionally, we evaluated two propagator-based diffusion indices: mean squared displacement and return to zero probability. We also did a visual

analysis around the centrum semiovale.Results: All methods had reconstruction errors below 5% with low undersampling factors and with a wide range of noise levels. However, the CSD method had at least 1–2% lower NMSE than the other reconstruction methods at higher noise levels. MAP was the second-best method when using a sufficiently high number of q-space samples. MAP reconstruction showed better propagator-based diffusion indices for in vivo acquisitions. With undersampling factors greater than 4, MAP and CSI have noticeably more reconstruction error than CSD.Conclusion: Undersampled data were best reconstructed by means of CSD in simulations and in vivo. MAP was more accurate in the extraction of propagator-based indices, particularly for in vivo data.

Irarrázaval P., Firoozabadi A., Uribe S., Tejos C., Sing-Long C. (2019)
NOISE ESTIMATION FOR THE VELOCITY IN MRI PHASE-CONTRAST
Revista: Magnetic Resonance Imaging, Volumen 63
Abstract: The purpose of this study is to estimate the precision or statistical variability of the velocity measurements computed from MRI phase-contrast. From the analytical probability density function (PDF) of the phase in the signal we obtain the PDF of the velocity by means of an auto-convolution. This PDF allows the estimation of the precision of the velocity, important for the correct interpretation of the many parameters that are based on it. We show that for high Signal-to-Noise Ratio (SNR) voxels, the distribution is well approximated by a Gaussian distribution. On the other hand, this is not true for lower SNR voxels, where the distribution adopts a form in between the Gaussian and the uniform distributions. This was confirmed empirically. Also, knowing the PDF on a coil by coil basis it is possible to combine the data from multiple coils in an optimal way. We showed that the optimal combination reduces the resulting global variability of the velocity, in comparison with the commonly used Weighted Mean or with a SENSE reconstruction with R = 1.

Bousse, Alexandre; Courdurier, Matias ; Emond, Elise; Thielemans, Kris ; Hutton, Brian ; Irarrazaval, Pablo ; Visvikis, Dimitris (2019)
PET RECONSTRUCTION WITH NON-NEGATIVITY CONSTRAINT IN PROJECTION SPACE: OPTIMIZATION THROUGH HYPO-CONVERGENCE
Revista: IEEE Transactions on Medical Imaging, Volume 39, Numero 1
Abstract: Standard positron emission tomography (PET) reconstruction techniques are based on maximum-likelihood (ML) optimization methods, such as the maximum-likelihood expectation-maximization (MLEM) algorithm and its variations. Most methodologies rely on a positivity constraint on the activity distribution image. Although this constraint is meaningful from a physical point of view, it can be a source of bias for low-count/high-background PET, which can compromise accurate quantification. Existing methods that allow for negative values in the estimated image usually utilize a modified log-likelihood, and therefore break the data statistics. In this paper, we propose to incorporate the positivity constraint on the projections only, by approximating the (penalized) log-likelihood function by an adequate sequence of objective functions that are easily maximized without constraint. This sequence is constructed such that there is hypo-convergence (a type of convergence that allows the convergence of the maximizers under some conditions) to the original log-likelihood, hence allowing us to achieve maximization with positivity constraint on the projections using simple settings. A complete proof of convergence under weak assumptions is given. We provide results of experiments on simulated data where we compare our methodology with the alternative direction method of multipliers (ADMM) method, showing that our algorithm converges to a maximizer, which stays in the desired feasibility set, with faster convergence than ADMM. We also show that this approach reduces the bias, as compared with MLEM images, in necrotic tumors-which are characterized by cold regions surrounded by hot structures-while reconstructing similar activity values in hot regions.

Alexandra Tobisch, Thomas Schultz, Rüdiger Stirnberg, Gabriel Varela- Mattatall, Hans Knutsson, Pablo Irarrázaval, Tony Stöcker (2019)
COMPARISON OF BASIS FUNCTIONS AND Q- SPACE SAMPLING SCHEMES FOR ROBUST COMPRESSED SENSING RECONSTRUCTION ACCELERATING DIFFUSION SPECTRUM IMAGING
Revista: NMR IN BIOMEDICINE Volumen 32, Número 3
Abstract: Time constraints placed on magnetic resonance imaging often restrict the application of advanced diffusion MRI (dMRI) protocols in clinical

practice and in high throughput research studies. Therefore, acquisition strategies for accelerated dMRI have been investigated to allow for the collection of versatile and high quality imaging data, even if stringent scan time limits are imposed. Diffusion spectrum imaging (DSI), an advanced acquisition strategy that allows for a high resolution of intra-voxel microstructure, can be sufficiently accelerated by means of compressed sensing (CS) theory. CS theory describes a framework for the efficient collection of fewer samples of a data set than conventionally required followed by robust reconstruction to recover the full data set from sparse measurements. For an accurate recovery of DSI data, a suitable acquisition scheme for sparse q-space sampling and the sensing and sparsifying bases for CS reconstruction need to be selected. In this work we explore three different types of q-space undersampling schemes and two frameworks for CS reconstruction based on either Fourier or SHORE basis functions. After CS recovery, diffusion and microstructural parameters and orientational information are estimated from the reconstructed data by means of state-of-the-art processing techniques for dMRI analysis. By means of simulation, diffusion phantom and in vivo DSI data, an isotropic distribution of q-space samples was found to be optimal for sparse DSI. The CS reconstruction results indicate superior performance of Fourier-based CS-DSI compared to the SHORE-based approach. Based on these findings we outline an experimental design for accelerated DSI and robust CS reconstruction of the sparse measurements that is suitable for the application within time-limited studies.

ALVARO LORCA

Verástegui F., Lorca A., Olivares D.E., Negrete-Pincetic M., Gazmuri P. (2019)
AN ADAPTIVE ROBUST OPTIMIZATION MODEL FOR POWER SYSTEMS PLANNING WITH OPERATIONAL UNCERTAINTY
IEEE Transactions on Power Systems, Volumen 34 Número 6
Abstract: There is an increasing necessity for new long-term planning models to adequately assess the flexibility requirements of significant levels of short-term operational uncertainty in power systems with large shares of variable renewable energy. In this context, this paper proposes an adaptive robust optimization model for the generation and transmission expansion planning problem. The proposed model has a two-stage structure that separates investment and operational decisions, over a given planning horizon. The key attribute of this model is the representation of daily operational uncertainty through the concept of representative days and the design of uncertainty sets that determine load and renewable power over such days. This setup allows an effective representation of the flexibility requirements of a system with large shares of variable renewable energy, and the consideration of a broad range of operational conditions. To efficiently solve the problem, the column and constraint generation method is employed. Extensive computational experiments on a 20-bus and a 149-bus representation of the Chilean power system over a 20-year horizon show the computational efficiency of the proposed approach, and the advantages as compared to a deterministic model with representative days, due to an effective spatial placement of both variable resources and flexible resources.

Simsek Y., Lorca A., Urmee T., Bahri P.A. and Escobar R. (2019)
REVIEW AND ASSESSMENT OF ENERGY POLICY DEVELOPMENTS IN CHILE
Revista: Energy Policy Volumen 127
Abstract: In recent years, the Chilean energy sector has gone through a significant transformation. Chile ratified the ParisAgreement in 2017 and committed to develop policies to face climate change and to transition to a more sus-tainable energy system. Promoting renewable energy and energy efficiency became an essential strategy forChile to reduce emissions and reach its energy and environmental goals, which are addressed in various gov-ernmental studies. Further, Chile became successful in promoting renewable electricity production without feed-in tariffs. The current national goal is for at least 70% of the electricity in Chile to be generated from renewableenergy sources by 2050. Additionally, energy efficiency is to be implemented

in several sectors. This paperprovides a broad overview of the energy sector and review of the Chilean energy policy development andenvironmental targets with emphasis on recent years. Finally, it also proposes an assessment about existing andrequired energy policy instruments for Chilean energy sectors by considering the promotion of renewable energyand energy efficiency and analyses the associated potential challenges. This work can provide insights to decision makers to develop long-term sustainable energy plans for Chile to reach its energy and environmental goals.

Mena R., Escobar R., Lorca A., Negrete-Pincetic M. and Olivares D. (2019)
THE IMPACT OF CONCENTRATED SOLAR POWER IN ELECTRIC POWER SYSTEMS: A CHILEAN CASE STUDY
Revista: Applied Energy Volumen 235
Abstract: This paper presents a study about the impacts of the integration of concentrated solar power (CSP) with thermal energy storage (TES) in electric power systems. The main tool for this study is a comprehensive long-term power system capacity expansion planning model that integrates a specific module to represent the operation of CSP-TES power plants. The model determines the optimal investments on generation and transmission assets over a twenty-year planning horizon, ranging from 2018 until 2037, and employs projections for the various parameters involved (e.g. load growth, capital costs for the different generation technologies, fuels costs). One of the main features of the model is its ability to capture the hourly operational dynamics of the system through the consideration of multiple representative days for each of its investment periods. This feature allows a better understanding of the role of CSP-TES as a significant provider of flexibility to support a high penetration of variable renewable energy sources, as compared with traditional planning models based on load blocks. The model is applied to a case study for the Chilean electricity system. In order to study the impacts of CSP-TES, various scenarios of future capital costs and carbon tax levels are defined and analyzed for two market dominant CSP-TES technologies. The results show that for low CSP-TES capital costs, or high carbon taxes, the integration of CSP-TES in the system is significant towards year 2037, potentially reaching about one third of the total dispatched energy in the Chilean electric power system, yielding important operational, economic, and environmental benefits.

VLADIMIR MARIANOV

Marianov V., Eiselt H.A., Lüer-Villagra A. (2019)
THE FOLLOWER COMPETITIVE LOCATION PROBLEM WITH COMPARISON-SHOPPING.
Revista: Networks and Spatial Economics, Volumen 20
Abstract: In competitive settings, firms locate their stores to take advantage of consumers' behavior to maximize their market share. A common behavior is comparison-shopping: in this behavioral pattern, consumers visit multiple stores that sell non-identical products, which are mutual substitutes, before making their purchase decision. This behavior has never been included in location-prescribing models for competitive firms. Given existing branches of one firm, we address the location problem of a follower firm that locates its own branches. We present insights on the instance used by ReVelle in his maximum capture formulation, provide computational experience with one thousand 100-node instances, and consider a realistic case using a 353-node network of Santiago, Chile. The results are compared in terms of the demand captured by each firm and the locational patterns that result from different consumer behaviors.

Beneventti D., Bronfman A., Paredes-Belmar G., Marianov V. (2019)
A MULTI-PRODUCT MAXIMIN HAZMAT ROUTING-LOCATION PROBLEM WITH MULTIPLE ORIGIN-DESTINATION PAIRS
Revista: Journal of Cleaner Production, Volume 240
Abstract: The United Nations define Supply Chain Sustainability as "the management of environmental, social and economic impacts, and the encouragement of good governance practices

throughout the lifecycles of goods and services." (UN, 2015). We deal with the logistic network, an important component of the Supply Chain, in industries either generating or using hazardous material (HM) in some stage of their productive processes. A major concern when transporting HM or locating hazardous facilities is to minimize risks and hazards to the population and environment. Most studies on this issue only consider one type of HM and fail to differentiate populations with different degrees of vulnerability. This work addresses both the problem of locating hazardous facilities and routing HMs across a large, densely populated urban area, minimizing the associated costs and hazards imposed on the population. Populations, aggregated in centers, were differentiated into vulnerable populations, which are the hardest to evacuate in a short period of time, and non-vulnerable populations. Several types of HMs with different degrees of hazard were considered. We propose a multi-objective programming model with multiple origin-destination (OD) pairs that considers maximizing the minimum weighted distance between hazardous facilities and the exposed vulnerable population, maximizing the minimum weighted distance from HM transportation arcs to the exposed vulnerable population, minimizing the total hazard imposed on the non-vulnerable population, and routing and location costs. The methodology has been tested in the transportation network in the city of Santiago, Chile.

Lüer-Villagra A., Eiselt H.A. and Marianov. V. (2019)

A SINGLE ALLOCATION P-HUB MEDIAN PROBLEM WITH GENERAL PIECEWISE-LINEAR COSTS IN ARCS

Revista: Computers & Industrial Engineering Volumen 128

Abstract: Hubs are used in postal, air passenger transportation, and less-than-truckload (LTL) transportation industries to consolidate, sort, and classify the flows from multiple origins to multiple destinations (OD pairs). Hub-and-spoke networks are commonly designed to exploit economies of scale, and multiple cost functions have been proposed. Hub Location Problems have been used extensively to design hub-and-spoke networks. Notwithstanding the previous efforts in developing accurate cost functions in hub location problems, there is no as today a model flexible enough to represent various practical cost curves. To address this gap, we propose a single-allocation p-hub location problem, in which the cost of the flow on any arc of the network is modeled as a general piecewise-linear function. Inspired by the parcel delivery industry, we allow the existence of routes containing more than three arcs, i.e., any single route may use more than two hubs. The resulting model is hard to solve, even for small instances. We propose a math-heuristic (i.e., a heuristic with exact mathematical programming components), which allows us to solve instances with up to 200 nodes. We obtain solutions considering different cost functions, showing the stability and scalability of the model. Our experiments reveal the dependence between the cost function considered and both hub location and node.

Kroetz K., Shih J.-S., Siikamäki J.V., Marianov V., Krupnick A.., Chud Z. (2019)

SYSTEMATICALLY INCORPORATING ENVIRONMENTAL OBJECTIVES INTO SHALE GAS PIPELINE DEVELOPMENT: A BINARY INTEGER, MULTI-OBJECTIVE SPATIAL OPTIMIZATION MODEL

Revista: Environmental Science & Technology, Volumen 53, Número 12

Abstract: Shale gas pipeline development can have negative environmental impacts, including adverse effects on species and ecosystems through habitat loss, degradation, and fragmentation. From a societal perspective, pipeline development planning processes should account for such externalities. We develop a multi-objective binary integer-programming model, called the Multi Objective Pipeline Siting (MOPS) model, to incorporate habitat externalities into pipeline development and to estimate the tradeoffs between pipeline development costs and habitat impacts. We demonstrate the model using an application from Bradford and Susquehanna counties in northeastern Pennsylvania. We find that large amounts of habitat impacts could be avoided for relatively low cost, but that avoiding additional habitat impacts becomes gradually increasingly costly. For example, 11% of the habitat impact can be avoided at only a one percent cost increase relative a configuration which ignores habitat impacts, suggesting promising options to reduce habitat impacts associated with shale gas pipeline development. A model such as the one developed here could be used by oil and gas companies, communities and states as part of the pipeline siting

and permitting process to improve environmental outcomes.

MATÍAS NEGRETE

Verástegui F., Lorca A., Olivares D.E., Negrete-Pincetic M., Gazmuri P. (2019)
AN ADAPTIVE ROBUST OPTIMIZATION MODEL FOR POWER SYSTEMS PLANNING WITH OPERATIONAL UNCERTAINTY
Revista: IEEE Transactions on Power Systems, Volumen 34, Número 6
Abstract: There is an increasing necessity for new long-term planning models to adequately assess the flexibility requirements of significant levels of short-term operational uncertainty in power systems with large shares of variable renewable energy. In this context, this paper proposes an adaptive robust optimization model for the generation and transmission expansion planning problem. The proposed model has a two-stage structure that separates investment and operational decisions, over a given planning horizon. The key attribute of this model is the representation of daily operational uncertainty through the concept of representative days and the design of uncertainty sets that determine load and renewable power over such days. This setup allows an effective representation of the flexibility requirements of a system with large shares of variable renewable energy, and the consideration of a broad range of operational conditions. To efficiently solve the problem, the column and constraint generation method is employed. Extensive computational experiments on a 20-bus and a 149-bus representation of the Chilean power system over a 20-year horizon show the computational efficiency of the proposed approach, and the advantages as compared to a deterministic model with representative days, due to an effective spatial placement of both variable resources and flexible resources.

Salah F., Henríquez R., Wenzel G., Olivares D., Negrete-.Pincetic M. and Weinhardt C. (2019)
PORTFOLIO DESIGN OF A DEMAND RESPONSE AGGREGATOR WITH SATISFICING CONSUMERS
Revista: IEEE Transactions on Smart Grid, Volume 10 , Número 3
Abstract: This work studies the impact of consumer behavior on the portfolio design of a demand response (DR) aggregator. Consumer behavior is modeled using elements of satisficing theory. We develop an optimization model to decide the optimal portfolio of DR contracts for an aggregator participating in the electricity market. In our model, the aggregator must pay a premium to enable the participation of consumers who have a certain aspiration threshold, below which they will not participate. Thus, the proposed model determines the premiums to be offered to consumers in order to obtain a DR portfolio that maximizes the aggregator's operating surplus while satisfying the aspirations of participating consumers. Several simulations are performed to obtain insights on the value of the DR resource, and the importance of parameters used to model the consumer behavior.

Mena R., Escobar R., Lorca A., Negrete-Pincetic M. and Olivares D. (2019)
THE IMPACT OF CONCENTRATED SOLAR POWER IN ELECTRIC POWER SYSTEMS: A CHILEAN CASE STUDY
Revista: Applied Energy Volumen 235
Abstract: This paper presents a study about the impacts of the integration of concentrated solar power (CSP) with thermal energy storage (TES) in electric power systems. The main tool for this study is a comprehensive long-term power system capacity expansion planning model that integrates a specific module to represent the operation of CSP-TES power plants. The model determines the optimal investments on generation and transmission assets over a twenty-year planning horizon, ranging from 2018 until 2037, and employs projections for the various parameters involved (e.g. load growth, capital costs for the different generation technologies, fuels costs). One of the main features of the model is its ability to capture the hourly operational dynamics of the system through the consideration of multiple representative days for each of its investment periods. This feature allows a better understanding of the role of CSP-TES as a significant provider of flexibility to support a high penetration of variable

renewable energy sources, as compared with traditional planning models based on load blocks. The model is applied to a case study for the Chilean electricity system. In order to study the impacts of CSP-TES, various scenarios of future capital costs and carbon tax levels are defined and analyzed for two market dominant CSP-TES technologies. The results show that for low CSP-TES capital costs, or high carbon taxes, the integration of CSP-TES in the system is significant towards year 2037, potentially reaching about one third of the total dispatched energy in the Chilean electric power system, yielding important operational, economic, and environmental benefits.

FELIPE NÚÑEZ

Orostica B., Nuñez F. (2019)
A MULTI-CAST ALGORITHM FOR ROBUST AVERAGE CONSENSUS OVER INTERNET OF THINGS ENVIRONMENTS
Revista: Computer Communications Volumen 140-141
Abstract: The initial cloud-managed-network conceptualization of the IoT has mutated into a sparsely coupled, distributed system of interacting smart objects, or things. In this context, distributed control techniques have emerged as a tool for performing tasks locally without the support of a back-end infrastructure. Consensus algorithms are the flagship of distributed control and find application in solving problems as varied as distributed task assignment, distributed estimation, and distributed optimization. Unfortunately, typical consensus algorithms deteriorate their performance when faced with realistic communication phenomena as asynchronous communications, packet losses and channel delays. In this work, an algorithm for achieving average consensus over an IoT environment is introduced and evaluated extensively in a large-scale IoT testbed. Evaluation results show that the proposed algorithm achieves average consensus in all evaluated scenarios despite heterogeneity in the network in terms of processing and networking capabilities, packet losses and delays.

Langarica S., Ruffelmacher C., Núñez F. (2019)
AN INDUSTRIAL INTERNET APPLICATION FOR REAL-TIME FAULT DIAGNOSIS IN INDUSTRIAL MOTORS
Revista: IEEE Transactions on Automation Science and Engineering, Volume 17 , Número 1
Abstract: Being able to detect, identify, and diagnose a fault is a key feature of industrial supervision systems, which enables advance asset management, in particular, predictive maintenance, which greatly increases efficiency and productivity. In this paper, an Industrial Internet app for real-time fault detection and diagnosis is implemented and tested in a pilot scale industrial motor. Real-time fault detection and identification is based on dynamic incremental principal component analysis (DIPCA) and reconstruction-based contribution (RBC). When the analysis indicates that one of the vibration measurements is responsible for the fault, a convolutional neural network (CNN) is used to identify the unbalance or bearing fault type. The application was evaluated in its three functionalities: fault detection, fault identification, and fault identification of vibration-related faults, yielding a fault detection rate over 99%, a false alarm rate below 5%, and an identification accuracy over 90%.

Mendoza J.J., Núñez F. (2019)
BLOCKCHAIN-DRIVEN ON-DEMAND CONTROL LOOPS OVER IOT ENVIRONMENTS
Revista: IEEE Access Volumen 7
Abstract: The feedback control loop is the atomic unit in a control system. Typically, feedback control loops are rigid objects that involve a dynamical system, or plant, which has a set of its output states measured by dedicated sensors, which in turn feed a processing unit, known as controller, that calculates actions to be applied as inputs to the plant, via elements known as actuators, in order to drive the outputs to a desired value or trajectory. The appearance of the Internet of Things (IoT) paradigm, where a large number of sensors and processing units interact over a communication network, offers an underlying infrastructure to operate and configure control loops using a different logic: an on-demand strategy. This work introduces the concept of on-demand control loop,

and proposes the use of blockchain technology as the enabling infrastructure for generating on-demand control loops over large-scale IoT environments. General design guidelines are given and a simple implementation example over the Ethereum blockchain is presented, which shows the feasibility of the proposed technique.

Núñez F., Langarica S., Díaz P., Torres M., Salas J.C. (2019)
NEURAL NETWORK-BASED MODEL PREDICTIVE CONTROL OF A PASTE THICKENER OVER AN INDUSTRIAL INTERNET PLATFORM
Revista: IEEE Transactions on Industrial Informatics Volume 16 Issue 4
Abstract: This article presents a real implementation of a neural network-based model predictive control scheme (NNMPC) to control an industrial paste thickener. The implementation is done over an Industrial Internet of Things (IIoT) platform designed using the seven layer reference model for IIoT systems. Modeling is achieved using an encoder-decoder with attention recurrent neural network, while MPC search is done using particle swarm optimization. An industrial evaluation is presented, which highlights the set-point tracking and disturbance rejection capabilities of the proposed NNMPC technique.

CHRISTIAN OBERLI

Castro L., Gironás J., Escauriaza C., Barría P., Oberli C. (2019)
METEOROLOGICAL CHARACTERIZATION OF FLOODS IN A MOUNTAINOUS POORLY GAUGED CATCHMENT USING PRINCIPAL COMPONENT ANALYSIS
Revista: Journal of Hydrologic Engineering Volumen 24
Abstract: Decision making and hydrologic design for coping with floods are complex tasks in poorly gauged high-relief basins. The response of such basins is driven by precipitation and temperature, which controls the freezing level elevation and size of the runoff contributing area. Moreover, early warning of floods based solely on real-time in situ monitoring is impractical. This study presents ameteorological characterization of daily flows based on off-site daily precipitation and temperature data in a high-relief catchment in central Chile. The results show that the variables that best explain daily discharges are the cumulative precipitation over the previous 3 days measured at a high elevation and the minimum temperature on the day of the maximum discharge measured at a lower elevation in the valley. These variables were used to build three multivariate regression models, based on principal component analysis, which are able to predict the occurrence of daily flows, particularly for low exceedance probabilities. Although developed for particular catchment, and despite the specific meteorological threshold magnitudes identified for the catchment, the analysis is easily extendable to other similar high-relief locations.

DANIEL OLIVARES

Llanos J., Olivares D.E., Simpson-Porco J.W., Karezani M., Sáez D. (2019)
A NOVEL DISTRIBUTED CONTROL STRATEGY FOR OPTIMAL DISPATCH OF ISOLATED MICROGRIDS CONSIDERING CONGESTION
Revista: IEEE Transactions on Smart Grid Volume 10, Issue 6
Abstract: This paper presents a novel distributed control strategy for frequency control, congestion management, and optimal dispatch (OD) in isolated microgrids. The proposed strategy drives the distributed generators (DGs) within the microgrid to a dispatch that complies with the Karush–Kuhn–Tucker (KKT) conditions of a linear optimal power flow (OPF) formulation. The controller relies on local power and frequency measurements,

information from neighboring DGs, and line-flow measurements transmitted through a communications network. Extensive simulations show a good performance of the controller against sudden changes in the load, congested lines and availability of DGs in the microgrid, and the ability to successfully drive the system to an optimal economic operation.

Verástegui F., Lorca A., Olivares D.E., Negrete-Pincetic M., Gazmuri P. (2019)
AN ADAPTIVE ROBUST OPTIMIZATION MODEL FOR POWER SYSTEMS PLANNING WITH OPERATIONAL UNCERTAINTY
Revista: IEEE Transactions on Power Systems Volumen 34, Número 6
Abstract: There is an increasing necessity for new long-term planning models to adequately assess the flexibility requirements of significant levels of short-term operational uncertainty in power systems with large shares of variable renewable energy. In this context, this paper proposes an adaptive robust optimization model for the generation and transmission expansion planning problem. The proposed model has a two-stage structure that separates investment and operational decisions, over a given planning horizon. The key attribute of this model is the representation of daily operational uncertainty through the concept of representative days and the design of uncertainty sets that determine load and renewable power over such days. This setup allows an effective representation of the flexibility requirements of a system with large shares of variable renewable energy, and the consideration of a broad range of operational conditions. To efficiently solve the problem, the column and constraint generation method is employed. Extensive computational experiments on a 20-bus and a 149-bus representation of the Chilean power system over a 20-year horizon show the computational efficiency of the proposed approach, and the advantages as compared to a deterministic model with representative days, due to an effective spatial placement of both variable resources and flexible resources.

Burgos-Mellado C., Llanos J., Cárdenas R., Sáez D., Olivares D.E., Summer M., Costabeber A. (2019)
DISTRIBUTED CONTROL STRATEGY BASED ON A CONSENSUS ALGORITHM AND ON THE CONSERVATIVE POWER THEORY FOR IMBALANCE AND HARMONIC SHARING IN 4-WIRE MICROGRIDS
Revista: IEEE Transactions on Smart Grid, Volume 11 Número 2
Abstract: A distributed control system is proposed which uses the Conservative Power Theory (CPT) and a consensus algorithm to share imbalance and harmonics between different converters in three-phase four-wire droop-controlled Microgrids (MGs). The CPT is used to identify the balanced, unbalanced and distorted components of the currents and powers in the system. Control loops based on virtual impedance and implemented in the stationary a-b-c frame are then used to distribute these components between the various converters in the MG. The magnitudes of the virtual impedances are adaptively calculated using a novel consensus-based distributed control scheme with the aim of sharing imbalances and harmonics according to the residual VA capacity of each converter whilst regulating the imbalance and distortion at their output to meet the appropriate IEEE power quality standards. Extensive simulations show that the proposed distributed control has excellent performance, and experimental validation is provided using a laboratory-scale 4-wire MG.

Salah F., Henríquez R., Wenzel G., Olivares D., Negrete-.Pincetic M. and Weinhardt C. (2019)
PORTFOLIO DESIGN OF A DEMAND RESPONSE AGGREGATOR WITH SATISFICING CONSUMERS
Revista: IEEE Transactions on Smart Grid Volume 10 , Número 3
Abstract: This work studies the impact of consumer behavior on the portfolio design of a demand response (DR) aggregator. Consumer behavior is modeled using elements of satisficing theory. We develop an optimization model to decide the optimal portfolio of DR contracts for an aggregator participating in the electricity market. In our model, the aggregator must pay a premium to enable the participation of consumers who have a certain aspiration threshold, below which they will not participate. Thus, the proposed model determines the premiums to be offered to consumers in order to obtain a DR portfolio that maximizes the aggregator's operating surplus while satisfying the aspirations of participating consumers. Several simulations are performed to obtain insights on the value of the DR resource, and the importance of parameters used to model the consumer behavior.

Lara J.D., Olivares D.E. and Cañizares C.A. (2019)
ROBUST ENERGY MANAGEMENT OF ISOLATED MICROGRIDS
Revista: IEEE Systems Journal Volume 13 , Número 1

Abstract: This paper presents the mathematical formulation and architecture of a robust energy management system for isolated microgrids featuring renewable energy, energy storage, and interruptible loads. The proposed strategy addresses the challenges of renewable energy variability and forecast uncertainty using a two-stage decision process combined with a receding horizon approach. The first-stage decision variables are determined using a cutting-plane algorithm to solve a robust unit commitment; the second stage solves the final dispatch commands using a three-phase optimal power flow. This novel approach is tested on a modified International Council on Large Electric Systems (CIGRE) test system under different conditions. The proposed algorithm is able to produce reliable dispatch commands without considering probabilistic information from the forecasting system. These results are compared with deterministic and stochastic formulations. The benefits of the proposed control are demonstrated by a reduction in load interruption events and by increasing available reserves without an increase in overall costs.

Mena R., Escobar R., Lorca A., Negrete-Pincetic M. and Olivares D. (2019)
THE IMPACT OF CONCENTRATED SOLAR POWER IN ELECTRIC POWER SYSTEMS: A CHILEAN CASE STUDY
Revista: Applied Energy Volumen 235

Abstract: This paper presents a study about the impacts of the integration of concentrated solar power (CSP) with thermal energy storage (TES) in electric power systems. The main tool for this study is a comprehensive long-term power system capacity expansion planning model that integrates a specific module to represent the operation of CSP-TES power plants. The model determines the optimal investments on generation and transmission assets over a twenty-year planning horizon, ranging from 2018 until 2037, and employs projections for the various parameters involved (e.g. load growth, capital costs for the different generation technologies, fuels costs). One of the main features of the model is its ability to capture the hourly operational dynamics of the system through the consideration of multiple representative days for each of its investment periods. This feature allows a better understanding of the role of CSP-TES as a significant provider of flexibility to support a high penetration of variable renewable energy sources, as compared with traditional planning models based on load blocks. The model is applied to a case study for the Chilean electricity system. In order to study the impacts of CSP-TES, various scenarios of future capital costs and carbon tax levels are defined and analyzed for two market dominant CSP-TES technologies. The results show that for low CSP-TES capital costs, or high carbon taxes, the integration of CSP-TES in the system is significant towards year 2037, potentially reaching about one third of the total dispatched energy in the Chilean electric power system, yielding important operational, economic, and environmental benefits.

Bustos C., Watts D., Olivares D. (2019)
THE EVOLUTION OVER TIME OF DISTRIBUTED ENERGY RESOURCE'S PENETRATION: A ROBUST FRAMEWORK TO ASSESS THE FUTURE IMPACT OF PROSUMAGE UNDER DIFFERENT TARIFF DESIGNS
Revista: Applied Energy, Volumen 256

Abstract: In the future, drastic cost reductions of Distributed Energy Resources will probably drive their deployment without the need of economic incentives – especially photovoltaic energy. Dynamic Grid Parity Models combine learning curves with grid-parity. They are the state-of-the-art solution to assess the time-evolving competitiveness of generation technologies, but fail to capture the residential end-user's choices of installing Distributed Energy Resources once they become feasible. We propose a robust framework based on a local and optimal microgrid combined with learning curves to assess the potential penetration of Distributed Energy Resources in households. This framework adds a notably richer interaction between the elements of the distribution system, e.g., optimal dispatch or peak shaving. We quantify the time-evolution of residential end-user's bills and the utility's revenue, applied to four tariff designs. Today Chile pioneers a massive deployment of photovoltaic systems without incentives, becoming a unique example worldwide, specially the so called "Solar City of Diego de Almagro", a town with a remarkable solar resource and massive PV deployment, chosen as the case study. Results show PV dominance with

flat bundled volumetric tariffs and the increase of utility's bankruptcy risk if tariffs are not updated (47% revenue reduction). If updated, bills would increase 24%, affecting non-owners. A two-part tariff overcomes this but it is regressive and it delays PV deployment. A three-part tariff improves efficiency and introduces prosumage, with a small peak-shaving effect. Owners could face regulatory risks due to possible tariff design changes. This study lays the foundation for future rate cases, and for distribution and transmission planning.

JAVIER PEREDA

Zhang X., Tian M., Xiang X., Pereda J., Green T.C. and Yang X. (2019)
LARGE STEP RATIO INPUT-SERIES-OUTPUT-PARALLEL CHAIN-LINK DC-DC CONVERTER
Revista: IEEE Transactions on Power Electronics Volumen 34, Número 5
Abstract: High-voltage and high-power dc-dc conversion is key to dc transmission, distribution and generation, which require compact and efficient dc transformers with large step ratios. This paper introduces a dc-dc converter with the input-series-output-parallel (ISOP) arrangement of multiple high step ratio sub-converter units. Each sub-converter unit is an isolated modular dcdc converter with a stack of half-bridge cells chopping the dc down to low voltage level. The transformer provides galvanic isolation and additional step ratio. The converter achieves a large step ratio due to the combination of the series-parallel configuration, the modular cells, and the isolation transformer. The proposed dc-dc converter is analyzed in a 30 kV to 1 kV, 1 MW application to discuss the operation performance, trade-offs, power efficiency and selection of components. Finally, the converter is validated through a laboratory down-scaled prototype.

Durán T., Neira S., Pereda J., Rojas F. (2019)
NEW DUAL H-BRIDGE CONVERTER FOR CONTINUOUS SPACE VECTOR MODULATION
Revista: IET Power Electronics, Volumen 12, Número 5
Abstract: Multilevel converters are a significant improvement in the DC-AC conversion technology, reaching higher power quality in medium-voltage applications and using standard semiconductors in a smarter way than conventional converters, without necessarily increasing the cost. However, multilevel technology remains discrete and its only way to reduce the overall total harmonic distortion leads on the generation of several discrete levels on the output voltage. Therefore, it is not possible to reduce the harmonic distortion to negligible values, unless a big number of semiconductors are used, which is not cost-effective for low-voltage applications, limiting the reliability of the system. This study proposes a new dual H-bridge inverter that generates a three-phase output voltage with negligible distortion using two variable DC-DC power sources and a new continuous space vector modulation. Simulation and experimental results show high-quality output voltages. The topology is simple and uses only 12 semiconductors, but it requires special attention in the variable DC voltage converters, which can limit the maximum output frequency. Therefore, the solution is suitable for low power applications that require high power quality using small filters or none filters at the AC side. The results were obtained and validated using an experimental laboratory prototype under different operating conditions.

Pineda C., Pereda J., Rojas F., Cerda C., Zhang X., Watson A. (2019)
ASYMMETRICAL TRIANGULAR CURRENT MODE (ATCM) FOR BIDIRECTIONAL HIGH STEP RATIO MODULAR MULTILEVEL DC-DC CONVERTER
Revista: IEEE Transactions on Power Electronics, Volume 35, Issue 7
Abstract: Direct current (Dc) networks have proven advantages in high voltage direct current (HVDC) transmission systems, and now they are expanding to medium- and low-voltage distribution networks. One of the major challenges is to develop reliable dc-dc voltage transformation achieving high efficiency and performance, especially at high voltage and high step ratio. New resonant modular multilevel topologies have arisen as an alternative, mainly because of advantages such as optional use of transformers, natural voltage balance, simple

control, and soft-switching capability. However, this type of operation generates a high peak current, does not allow control of power flow in all power range, and has a limited range of voltage variation. This article proposes an asymmetrical triangular current mode applied to high step ratio modular multilevel dc-dc converters. The proposed modulation increases the efficiency and achieves bidirectional control of the power, soft-switching, and a natural balance of the voltage in the cell capacitors. The experimental results show the bidirectional operation and the capacitor voltage balance of the converter under different operating conditions with higher efficiency (97.72%) and lower peak current compared to previous reports of this topology using resonant operation.

Rojas F., Cardenas R., Clare J., Diaz M., Pereda J., Kennel R. (2019)
A DESIGN METHODOLOGY OF MULTI-RESONANT CONTROLLERS FOR HIGH PERFORMANCE 400HZ GROUND POWER UNITS
Revista: IEEE Transactions on Industrial Electronics, Volumen 66, Número 8
Abstract: In aerospace applications, a ground power unit has to provide balanced and sinusoidal 400 Hz phase-toneutral voltages to unbalanced and nonlinear single-phase loads. Compensation of high-order harmonics is complex, as the ratio between the sampling frequency and compensated harmonics can be very small. Thus, multiple superimposed resonant controllers or proportional-integral (PI) nested controllers in multiple dq frames are not good alternatives. The first approach cannot ensure stability, while the second cannot track the sinusoidal zero-sequence components typically present in unbalanced systems, and unattainably high bandwidth at the inner current control loop is typically required. In this paper, a simple methodology for designing a single-loop, multiple resonant controller for simultaneous mitigation of several high-order harmonics, ensuring stability, is presented. Experimental results, based on a 6 kW four-leg neutral point clamped converter, validate the proposed controller design, showing excellent steady-state and transient performance.

CLAUDIA PRIETO

Küstner T., Bustin A., Jaubert O., Neji R., Prieto C., Botnar R. (2019)
3D CARTESIAN FAST INTERRUPTED STEADY-STATE (FISS) IMAGING
Revista : Magnetic Resonance in Medicine, Volumen 82, Número 5
Abstract: PURPOSE:To enable intrinsic and efficient fat suppression in 3D Cartesian fast interrupted steady-state (FISS) acquisitions.METHODS:A periodic interruption of the balanced steady-state free precession (bSSFP) readout train (FISS) has been previously proposed for 2D radial imaging. FISS modulates the bSSFP frequency response pattern in terms of shape, width and location of stop band (attenuated transverse magnetization). Depending on the FISS interruption rate, the stop band characteristic can be exploited to suppress the fat spectrum at 3.5 ppm, thus yielding intrinsic fat suppression. For conventional 2D Cartesian sampling, ghosting/aliasing artifacts along phase-encoding direction have been reported. In this work, we propose to extend FISS to 3D Cartesian imaging and report countermeasures for the previously observed ghosting/aliasing artifacts. Key parameters (dummy prepulses, spatial resolution, and interruption rate) are investigated to optimize fat suppression and image quality. FISS behavior is examined using extended phase graph simulations to recommend parametrizations which are validated in phantom and in vivo measurements on a 1.5T MRI scanner for 3 applications: upper thigh angiography, abdominal imaging, and free-running 5D CINE.RESULTS:Using optimized parameters, 3D Cartesian FISS provides homogeneous and consistent fat suppression for all 3 applications. In upper thigh angiography, vessel structures can be recovered in FISS that are obscured in bSSFP. Fat suppression in free-running cardiac CINE resulted in less fat-related motion aliasing and yielded better image quality.CONCLUSION:3D Cartesian FISS is feasible and offers homogeneous intrinsic fat

suppression for selected imaging parameters without the need for dedicated preparation pulses, making it a promising candidate for free-running fat-suppressed imaging.

Nordio G., Bustin A., Henningsson M., Rashid I., Chiribiri A., Ismail T., Odile F., Prieto C. and Botnar R.M. (2019)

3D SASHA MYOCARDIAL T1 MAPPING WITH HIGH ACCURACY AND IMPROVED PRECISION

Revista: Magnetic Resonance Materials in Physics, Biology and Medicine, Volume 32

Abstract: PURPOSE:To improve the precision of a free-breathing 3D saturation-recovery-based myocardial T1 mapping sequence using a post-processing 3D denoising technique.METHODS:A T1 phantom and 15 healthy subjects were scanned on a 1.5 T MRI scanner using 3D saturation-recovery single-shot acquisition (SASHA) for myocardial T1 mapping. A 3D denoising technique was applied to the native T1-weighted images before pixel-wise T1 fitting. The denoising technique imposes edge-preserving regularity and exploits the co-occurrence of 3D spatial gradients in the native T1-weighted images by incorporating a multi-contrast Beltrami regularization. Additionally, 2D modified Look-Locker inversion recovery (MOLLI) acquisitions were performed for comparison purposes. Accuracy and precision were measured in the myocardial septum of 2D MOLLI and 3D SASHA T1 maps and then compared. Furthermore, the accuracy and precision of the proposed approach were evaluated in a standardized phantom in comparison to an inversion-recovery spin-echo sequence (IRSE).RESULTS:For the phantom study, Bland-Altman plots showed good agreement in terms of accuracy between IRSE and 3D SASHA, both on non-denoised and denoised T1 maps (mean difference -1.4 ± 18.9 ms and -4.4 ± 21.2 ms, respectively), while 2D MOLLI generally underestimated the T1 values (69.4 ± 48.4 ms). For the in vivo study, there was a statistical difference between the precision measured on 2D MOLLI and on non-denoised 3D SASHA T1 maps (P = 0.005), while there was no statistical difference after denoising (P = 0.95).CONCLUSION:The precision of 3D SASHA myocardial T1 mapping was substantially improved using a 3D Beltrami regularization based denoising technique and was similar to that of 2D MOLLI T1 mapping, while preserving the higher accuracy and whole-heart coverage of 3D SASHA.

Bustin A., Ginami G., Cruz G., Correia T., Tevfik I., Rashid I., Neji R., Botnar R., and Prieto C. (2019)

FIVE -MINUTE WHOLE -HEART CORONARY MRA WITH SUB -MILLIMETER ISOTROPIC RESOLUTION, 100% RESPIRATORY SCAN EFFICIENCY AND 3D-PROST RECONSTRUCTION

Revista: Magnetic Resonance in Medicine, Volumen 81, Número 1

Abstract: Purpose: To enable whole-heart three-dimensional (3D) coronary magnetic resonance angiography (CMRA) with isotropic sub-millimeter resolution in a clinically feasible scan time by combining respiratory motion correction with highly accelerated variable density sampling in concert with a novel 3D patch-based undersampled reconstruction (3D PROST). Methods: An undersampled variable density spiral-like Cartesian trajectory was combined with 2D image-based navigators to achieve 100% respiratory efficiency and predictable scan time. 3D-PROST reconstruction integrates structural information from 3D patch neighborhoods through sparse representation, thereby exploiting the redundancy of the 3D anatomy of the coronary arteries in an efficient low-rank formulation. The proposed framework was evaluated in a static resolution phantom and in ten healthy subjects with isotropic resolution of 1.2mm3 and 0.9mm3 and undersampling factors of x5 and x9. 3D PROST was compared against fully-sampled (1.2mm3 only), conventional parallel imaging and compressed sensing reconstructions. Results: Phantom and in vivo (1.2mm3) reconstructions were in excellent agreement with the reference fully-sampled image. In vivo average acquisition times (min:sec) were 7:57±1:18 (x5) and 4:35±0:44 (x9) for 0.9mm3 resolution. Sub-millimeter 3D-PROST resulted in excellent depiction of the left and right coronary arteries including small branch vessels, leading to further improvements in vessel sharpness and visible vessel length in comparison with conventional reconstruction techniques. Image quality rated by two experts demonstrated that 3D-PROST provides good image quality and is robust even at high acceleration factors. Conclusion: The proposed approach enables free-breathing whole-heart 3D CMRA with isotropic sub-millimeter resolution in less than 5 minutes and achieves improved coronary artery visualization in a short and predictable scan time.

Qi H., Jaubert O., Bustin A., Cruz G., Chen H., Botnar R., Prieto C. (2019)

FREE-RUNNING 3D WHOLE HEART MYOCARDIAL T1 MAPPING WITH ISOTROPIC SPATIAL RESOLUTION

Revista : Magnetic Resonance in Medicine, Volumen 82, Número 4

Abstract: PURPOSE:To develop a free-running (free-breathing, retrospective cardiac gating) 3D myocardial T1 mapping with isotropic spatial resolution.METHODS:The free-running sequence is inversion recovery (IR)-prepared followed by continuous 3D golden angle radial data acquisition. 1D respiratory motion signal is extracted from the k-space center of all spokes and used to bin the k-space data into different respiratory states, enabling estimation and correction of 3D translational respiratory motion, whereas cardiac motion is recorded using electrocardiography and synchronized with data acquisition. 3D translational respiratory motion compensated T1 maps at diastole and systole were generated with 1.5 mm isotropic spatial resolution with low-rank inversion and high-dimensionality patch-based undersampled reconstruction. The technique was validated against conventional methods in phantom and 9 healthy subjects.RESULTS:Phantom results demonstrated good agreement (R2 = 0.99) of T1 estimation with reference method. Homogeneous systolic and diastolic 3D T1 maps were reconstructed from the proposed technique. Diastolic septal T1 estimated with the proposed method (1140 ± 36 ms) was comparable to the saturation recovery single-shot acquisition (SASHA) sequence (1153 ± 49 ms), but was higher than the modified Look-Locker inversion recovery (MOLLI) sequence (1037 ± 33 ms). Precision of the proposed method (42 ± 8 ms) was comparable to MOLLI (41 ± 7 ms) and improved with respect to SASHA (87 ± 19 ms).CONCLUSIONS:The proposed free-running whole heart T1 mapping method allows for reconstruction of isotropic resolution 3D T1 maps at different cardiac phases, serving as a promising tool for whole heart myocardial tissue characterization.

Qi H, Bustin A, Cruz G, Jaubert O, Chen H, Botnar RM, Prieto C.

FREE-RUNNING SIMULTANEOUS MYOCARDIAL T1/T2 MAPPING AND CINE IMAGING WITH 3D WHOLE-HEART COVERAGE AND ISOTROPIC SPATIAL RESOLUTION

Revista: Magnetic Resonance Imaging, Volumen 63

Abstract: PURPOSE:To develop a free-running framework for 3D isotropic simultaneous myocardial T1/T2 mapping and cine imaging.METHODS:Continuous data acquisition with 3D golden angle radial trajectory is used in conjunction with T2 preparation of varying echo times and inversion recovery (IR) pulses to enable simultaneous myocardial T1/T2 mapping and cine imaging. Data acquisition is retrospectively synchronized with ECG signal, and 1D respiratory self-navigation signal is extracted from the k-space center of all radial spokes. Respiratory binning is performed based on the estimated respiratory signal, enabling estimation and correction of 3D translational respiratory motion. Using high-dimensionality patch-based undersampled reconstruction with dictionary-based low-rank inversion, whole-heart T1/T2 maps and cine images can be generated with 2 mm isotropic spatial resolution. The proposed technique was validated in a standardised phantom and ten healthy subjects in comparison to conventional 2D imaging techniques.RESULTS:Phantom T1 and T2 measurements demonstrated good agreement with 2D spin echo techniques. Septal T1 estimated with the proposed technique (1185.6 ± 49.8 ms) was longer than with a conventional breath-hold 2D IR-prepared sequence (1044.3 ± 26.7 ms), whereas T2 measurements (47.6 ± 2.5 ms) were lower than a breath-hold 2D gradient spin echo sequence (52.0 ± 1.8 ms). Precision of the proposed 3D mapping was higher than conventional 2D mapping techniques. Ejection fraction measured with the proposed 3D approach (63.8 ± 6.8%) agreed well with conventional breath-held multi-slice 2D cine (62.3 ± 6.4%).CONCLUSIONS:The proposed technique provides co-registered 3D T1/T2 maps and cine images with isotropic spatial resolution from a single free-breathing scan, thereby providing a promising imaging tool for whole-heart myocardial tissue characterization and functional evaluation.

Ginami G., López K., Mukherjee R.K., Neje R., Muñoz C., Roujol S., Mountney P., Razavi R., Botnar R.M. and Prieto C. (2019)

NON-CONTRAST ENHANCED SIMULTANEOUS 3D WHOLE-HEART BRIGHT-BLOOD PULMONARY VEINS VISUALIZATION AND BLACK-BLOOD QUANTIFICATION OF ATRIAL WALL THICKNESS

Revista : Magnetic Resonance in Medicine, Volumen 81, Número 2

Abstract: PURPOSE:Pre-interventional assessment of atrial wall thickness (AWT) and of subject-specific variations in the anatomy of the pulmonary veins may affect the success rate of RF ablation procedures for the treatment of atrial fibrillation (AF). This study introduces a novel non-contrast enhanced 3D whole-heart sequence providing simultaneous information on the cardiac anatomy-including both the arterial and the venous system-(bright-blood volume) and AWT (black-blood volume).METHODS:The proposed MT-prepared bright-blood and black-blood phase sensitive inversion recovery (PSIR) BOOST framework acquires 2 differently weighted bright-blood volumes in an interleaved fashion. The 2 data sets are then combined in a PSIR-like reconstruction to obtain a complementary black-blood volume for atrial wall visualization. Image-based navigation and non-rigid respiratory motion correction are exploited for 100% scan efficiency and predictable acquisition time. The proposed approach was evaluated in 11 healthy subjects and 4 patients with AF scheduled for RF ablation.RESULTS:Improved depiction of the cardiac venous system was obtained in comparison to a T2 -prepared BOOST implementation, and quantified AWT was shown to be in good agreement with previously reported measurements obtained in healthy subjects (right atrium AWT: 2.54 ± 0.87 mm, left atrium AWT: 2.51 ± 0.61 mm). Feasibility for MT-prepared BOOST acquisitions in patients with AF was demonstrated.CONCLUSION:The proposed motion-corrected MT-prepared BOOST sequence provides simultaneous non-contrast pulmonary vein depiction as well as black-blood visualization of atrial walls. The proposed sequence has a large spectrum of potential clinical applications and further validation in patients is warranted.

Muñoz C., Neji R., Kunze K.P., Nekolla S., Botnar R.M. and Prieto C. (2019)

RESPIRATORY AND CARDIAC MOTION CORRECTED SIMULTANEOUS WHOLE-HEART PET AND DUAL PHASE CORONARY MR ANGIOGRAPHY

Revista: Magnetic Resonance in Medicine Volume 81, Issue3

Abstract: PURPOSE:To develop a framework for efficient and simultaneous acquisition of motion-compensated whole-heart coronary MR angiography (CMRA) and left ventricular function by MR and myocardial integrity by PET on a 3T PET-MR system. METHODS:An acquisition scheme based on a dual-phase CMRA sequence acquired simultaneously with cardiac PET data has been developed. The framework is integrated with a motion-corrected image reconstruction approach, so that non-rigid respiratory and cardiac deformation fields estimated from MR images are used to correct both the CMRA (respiratory motion correction for each cardiac phase) and the PET data (respiratory and cardiac motion correction). The proposed approach was tested in a cohort of 8 healthy subjects and 6 patients with coronary artery disease. Left ventricular (LV) function estimated from motion-corrected dual-phase CMRA was compared to the gold standard estimated from a stack of 2D CINE images for the healthy subjects. Relative increase of signal in motion-corrected PET images compared to uncorrected images was computed for standard 17-segment polar maps for each patient.RESULTS:Motion-corrected dual-phase CMRA images allow for visualization of the coronary arteries in both systole and diastole for all healthy subjects and cardiac patients. LV functional indices from healthy subjects result in good agreement with the reference method, underestimating stroke volume by 3.07 ± 3.26 mL and ejection fraction by 0.30 ± 1.01%. Motion correction improved delineation of the myocardium in PET images, resulting in an increased 18 F-FDG signal of up to 28% in basal segments of the myocardial wall compared to uncorrected images.CONCLUSION:The proposed motion-corrected dual-phase CMRA and cardiac PET produces co-registered good quality images in both modalities in a single efficient examination of ~13 min.

Cruz G., Jaubert O., Schneider T., Botnar R.M. and Prieto C. (2019)

RIGID MOTION-CORRECTED MAGNETIC RESONANCE FINGERPRINTING

Revista : Magnetic Resonance in Medicine, Volumen 81, Número 2

Abstract: PURPOSE:Develop a method for rigid body motion-corrected magnetic resonance fingerprinting (MRF).METHODS:MRF has shown some robustness to abrupt motion toward the end of the acquisition. Here, we study the effects of different types of rigid body motion during the acquisition on MRF and propose a novel approach to correct for this motion. The proposed method (MC-MRF) follows 4 steps: (1) sliding window reconstruction is performed to produce high-quality auxiliary dynamic images; (2) rotation and

translation motion is estimated from the dynamic images by image registration; (3) estimated motion is used to correct acquired k-space data with corresponding rotations and phase shifts; and (4) motion-corrected data are reconstructed with low-rank inversion. MC-MRF was validated in a standard T1/T2 phantom and 2D in vivo brain acquisitions in 7 healthy subjects. Additionally, the effect of through-plane motion in 2D MC-MRF was investigated.RESULTS:Simulation results show that motion in MRF can introduce artifacts in T1 and T2 maps, depending when it occurs. MC-MRF improved parametric map quality in all phantom and in vivo experiments with in-plane motion, comparable to the no-motion ground truth. Reduced parametric map quality, even after motion correction, was observed for acquisitions with through-plane motion, particularly for smaller structures in T2 maps.CONCLUSION:Here, a novel method for motion correction in MRF (MC-MRF) is proposed, which improves parametric map quality and accuracy in comparison to no-motion correction approaches. Future work will include validation of 3D MC-MRF to enable also through-plane motion correction.

Lima da Cruz G., Bustin A, Jaubert O, Schneider T., Botnar R.M., Prieto C. (2019)

SPARSITY AND LOCALLY LOW RANK REGULARIZATION FOR MR FINGERPRINTING

Revista: Magnetic Resonance in Medicine, Volumen 81, Número 6

Abstract: PurposeDevelop a sparse and locally low rank (LLR) regularized reconstruction to accelerate MR fingerprinting (MRF).MethodsRecent works have introduced low rank reconstructions to MRF, based on temporal compression operators learned from the MRF dictionary. In other MR applications, LLR regularization has been introduced to exploit temporal redundancy in local regions of the image. Here, we propose to include spatial sparsity and LLR regularization terms in the MRF reconstruction. This approach, so called SLLR-MRF, further reduces aliasing in the time-point images and enables higher acceleration factors. The proposed approach was evaluated in simulations, T1/T2 phantom acquisition, and in vivo brain acquisitions in 5 healthy subjects with different undersampling factors. Acceleration was also used in vivo to enable acquisitions with higher in-plane spatial resolution in comparable scan time.ResultsSimulations, phantom, and in vivo results show that low rank MRF reconstructions with high acceleration factors (<875 time-point images, 1 radial spoke per time-point) have residual aliasing artifacts that propagate into the parametric maps. The artifacts are reduced with the proposed SLLR-MRF resulting in considerable improvements in precision, without changes in accuracy. In vivo results show improved parametric maps for the proposed SLLR-MRF, potentially enabling MRF acquisitions with 1 radial spoke per time-point in approximately 2.6 s (~600 time-point images) for 2 × 2 mm and 9.6 s (1750 time-point images) for 1 × 1 mm in-plane resolution.ConclusionThe proposed SLLR-MRF reconstruction further improves parametric map quality compared with low rank MRF, enabling shorter scan times and/or increased spatial resolution.

CRISTIAN TEJOS

Varela G., Koch A., Stirnberg R., Chabert S., Uribe S., Tejos C., Stocker T., Irarrazaval P. (2019)

COMPARISON OF Q-SPACE RECONSTRUCTIONS METHODS FOR UNDERSAMPLED DIFFUSION SPECTRUM IMAGING DATA

Revista: Magnetic Resonance in Medical Sciences,Volume 19, Issue 2

Abstract: Purpose: To compare different q-space reconstruction methods for undersampled diffusion spectrum imaging data.Materials and Methods: We compared the quality of three methods: Mean Apparent Propagator (MAP); Compressed Sensing using Identity (CSI) and Compressed Sensing using Dictionary (CSD) with simulated data and in vivo acquisitions. We used retrospective undersampling so that the fully sampled reconstruction could be used as ground truth. We used the normalized mean squared error (NMSE) and the Pearson's correlation coefficient as reconstruction quality indices. Additionally, we evaluated two propagator-based diffusion indices: mean squared displacement and return to zero probability. We also did a visual analysis around the centrum semiovale.Results: All

methods had reconstruction errors below 5% with low undersampling factors and with a wide range of noise levels. However, the CSD method had at least 1–2% lower NMSE than the other reconstruction methods at higher noise levels. MAP was the second-best method when using a sufficiently high number of q-space samples. MAP reconstruction showed better propagator-based diffusion indices for in vivo acquisitions. With undersampling factors greater than 4, MAP and CSI have noticeably more reconstruction error than CSD.Conclusion: Undersampled data were best reconstructed by means of CSD in simulations and in vivo. MAP was more accurate in the extraction of propagator-based indices, particularly for in vivo data.

Irarrázaval P., Firoozabadi A., Uribe S., Tejos C., Sing-Long C. (2019)
NOISE ESTIMATION FOR THE VELOCITY IN MRI PHASE-CONTRAST
Revista : Magnetic Resonance Imaging, Volumen 63
Abstract: The purpose of this study is to estimate the precision or statistical variability of the velocity measurements computed from MRI phase-contrast. From the analytical probability density function (PDF) of the phase in the signal we obtain the PDF of the velocity by means of an auto-convolution. This PDF allows the estimation of the precision of the velocity, important for the correct interpretation of the many parameters that are based on it. We show that for high Signal-to-Noise Ratio (SNR) voxels, the distribution is well approximated by a Gaussian distribution. On the other hand, this is not true for lower SNR voxels, where the distribution adopts a form in between the Gaussian and the uniform distributions. This was confirmed empirically. Also, knowing the PDF on a coil by coil basis it is possible to combine the data from multiple coils in an optimal way. We showed that the optimal combination reduces the resulting global variability of the velocity, in comparison with the commonly used Weighted Mean or with a SENSE reconstruction with R = 1.

Rivera K., Salas-Pérez F., Evheverría G., Urquiaga I., Dicenta S., Pérez D., de la Cerda P., González L., Andía M. E., Uribe S., Tejos C., Martínez G., Busso D., Irarrázaval P., Rigotti A. (2019)
RED WINE GRAPE POMACE ATTENUATES ATHEROSCLEROSIS AND MYOCARDIAL DAMAGE AND INCREASES SURVIVAL IN ASSOCIATION WITH IMPROVED PLASMA ANTIOXIDANT ACTIVITY IN A MURINE MODEL OF LETHAL ISCHEMIC HEART DISEASE
Revista : Nutrients, Volumen 11, Número 9
Abstract: A healthy dietary pattern and high quality nutrient intake reduce atherosclerotic cardiovascular disease risk. Red wine grape pomace (RWGP)—a rich natural source of dietary fiber and antioxidants—appears to be a potential functional food ingredient. The impact of a dietary supplementation with RWGP flour was evaluated in atherogenic diet-fed SR-B1 KO/ApoER61h/h mice, a model of lethal ischemic heart disease. SR-B1 KO/ApoER61h/h mice were fed with atherogenic (high fat, cholesterol, and cholic acid, HFC) diet supplemented with: (a) 20% chow (HFC-Control), (b) 20% RWGP flour (HFC-RWGP), or (c) 10% chow/10% oat fiber (HFC-Fiber); and survival time was evaluated. In addition, SR-B1 KO/ApoER61h/h mice were fed for 7 or 14 days with HFC-Control or HFC-RWGP diets and plasma lipid levels, inflammation, oxidative damage, and antioxidant activity were measured. Atherosclerosis and myocardial damage were assessed by histology and magnetic resonance imaging, respectively. Supplementation with RWGP reduced premature death, changed TNF-α and IL-10 levels, and increased plasma antioxidant activity. Moreover, decreased atheromatous aortic and brachiocephalic plaque sizes and attenuated myocardial infarction and dysfunction were also observed. These results suggest that RWGP flour intake may be used as a non-pharmacological therapeutic approach, contributing to decreased progression of atherosclerosis, reduced coronary heart disease, and improved cardiovascular outcomes.

Pereira J.A., Sepulveda P., Rana M., Montalba C., Tejos C., Torres R., Sitaram R., Ruiz S. (2019)
SELF-REGULATION OF THE FUSIFORM FACE AREA IN AUTISM SPECTRUM: A FEASIBILITY STUDY WITH REAL-TIME FMRI NEUROFEEDBACK
Revista : Frontiers in Human Neuroscience, Volumen 13
Abstract: One of the most important and early impairments in autism spectrum disorder (ASD) is the abnormal visual processing of human faces. This deficit has been associated with hypoactivation of the fusiform face area (FFA), one of the main hubs of the face-processing network. Neurofeedback based on real-time fMRI (rtfMRI-NF) is a technique that allows the self-regulation of circumscribed

brain regions, leading to specific neural modulation and behavioral changes. The aim of the present study was to train participants with ASD to achieve up-regulation of the FFA using rtfMRI-NF, to investigate the neural effects of FFA up-regulation in ASD. For this purpose, three groups of volunteers with normal I.Q. and fluent language were recruited to participate in a rtfMRI-NF protocol of eight training runs in 2 days. Five subjects with ASD participated as part of the experimental group and received contingent feedback to up-regulate bilateral FFA. Two control groups, each one with three participants with typical development (TD), underwent the same protocol: one group with contingent feedback and the other with sham feedback. Whole-brain and functional connectivity analysis using each fusiform gyrus as independent seeds were carried out. The results show that individuals with TD and ASD can achieve FFA up-regulation with contingent feedback. RtfMRI-NF in ASD produced more numerous and stronger short-range connections among brain areas of the ventral visual stream and an absence of the long-range connections to insula and inferior frontal gyrus, as observed in TD subjects. Recruitment of inferior frontal gyrus was observed in both groups during FAA up-regulation. However, insula and caudate nucleus were only recruited in subjects with TD. These results could be explained from a neurodevelopment perspective as a lack of the normal specialization of visual processing areas, and a compensatory mechanism to process visual information of faces. RtfMRI-NF emerges as a potential tool to study visual processing network in ASD, and to explore its clinical potential.

Milovic C., Bilgic B., Zhao B., Langkammer C., Tejos C. and Acosta-Cabronero J. (2019)
WEAK-HARMONIC REGULARIZATION FOR QUANTITATIVE SUSCEPTIBILITY MAPPING
Revista : Magnetic Resonance in Medicine, Volumen 81, Número 2
Abstract: Purpose: Background-field removal is a crucial preprocessing step for quantitative susceptibility mapping (QSM). Remnants from this step often contaminate the estimated local field, which in turn lead to erroneous tissue-susceptibility reconstructions. The present work aimed to mitigate this undesirable behavior with the development of a new approach that simultaneously decouples background contributions and local susceptibility sources on QSM inversion.Methods: Input phase data for QSM can be seen as a composite scalar field of local effects and residual background components. We developed a new Weak-Harmonic (WH) regularizer to constrain the latter and to separate the two components. The resulting optimization problem was solved with the Alternating Directions of Multipliers Method (ADMM) framework to achieve fast convergence. In addition, for convenience a new ADMM-based preconditioned nonlinear Projection onto Dipole Fields (nPDF) solver was developed to enable initializations with wrapped-phase distributions. WH-QSM, with and without nPDF preconditioning, was compared to the original (ADMM-based) Total Variation QSM algorithm in phantom and in vivo experiments.Results: WH-QSM returned improved reconstructions irrespective of the method used for background- field removal, though the proposed nPDF method often obtained better results. Streaking and shadowing artifacts were substantially suppressed, and residual background components were effectively removed.Conclusion: WH-QSM with field preconditioning is a robust dipole inversion technique and has the potential to be extended as a single-step formulation for initialization with uncombined multi-echo data.

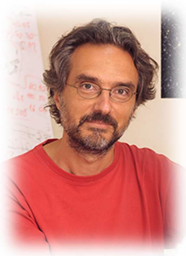
MIGUEL TORRES

Flores-Calero M., Torres-Torriti M., Retamales-Ortega F., Rosas-Díaz R. (2019)
PLATAFORMA DE PRESENCIA VIRTUAL DE BAJO COSTO PARA PERSONAS CON DISCAPACIDADES MOTORAS SEVERAS
Revista: Revista Iberoamericana de Automatica e Informatica Industrial, Volumen 17, Número 2
Abstract: Debido a la falta de autonomía y a la dificultad en las interacciones sociales, las personas con discapacidades físicas, generalmente sufren de una calidad de vida disminuida. El siguiente

documento describe el desarrollo de una plataforma móvil de bajo costo capaz de asistir a las personas con severas discapacidades motoras en diferentes interacciones sociales. La plataforma requiere una base móvil inalámbrica; adaptando dos dispositivos, una cámara y un rastreador ocular; adicionalmente se requiere un software que permite integrar todos los componentes para elaborar una aplicación fácil de usar. Luego, para validar la operación de la plataforma se realizaron varias pruebas, usando una metodología de medición de usabilidad, con diferentes usuarios dentro de un cierto rango de edad, con y sin discapacidades. En consecuencia, como primera instancia de validación, la plataforma de bajo costo cumple con la función esperada para la asistencia de interacción social de personas con discapacidad. Finalmente, al ser un diseño abierto y verificado su funcionamiento, toda la información necesaria para la construcción del aparato es de libre acceso, a través de la página electrónica del proyecto.

Amato N. M., Hager G., Thomas S., Torres-Torriti M. (2019)
SPECIAL ISSUE ON THE INTERNATIONAL SYMPOSIUM ON ROBOTICS RESEARCH, 2017
Revista: The International Journal of Robotics Research, Volumen 38, Número 12-13
Abstract: Welcome to this special edition of the International Journal of Robotics Research (IJRR), showcasing some of the most advanced and recent research in robotics. It features papers from the 2017 International Symposium on Robotics Research (ISRR), which was held in December 2017 in Puerto Varas, Chile. ISRR 2017 featured 53 full length papers, organized into ten sessions, and 16 “blue sky ideas” papers, organized into three sessions. The manuscripts in this special issue were carefully selected from those that received uniformly strong reviews. This issue includes 12 extended papers on the following topics:Blue sky ideas;Learning and perception;Planning;Human–robot interaction.The distribution of paper topics and themes provides a perspective on where energy is being devoted in the field. Planning had the greatest presence, with three sessions in the final ISRR 2017 program. This was followed by learning and perception, with two sessions focused on each.

Auat Cheein F., Torres-Torriti M., Rosell-Polo J.R. (2019)
USABILITY ANALYSIS OF SCAN MATCHING TECHNIQUES FOR LOCALIZATION OF FIELD MACHINERY IN AVOCADO GROVES
Revista: Computers and Electronics in Agriculture, Volumen 162
Abstract: When working in agricultural environments, specially in groves with dense foliage, machinery positioning systems might suffer from loss of GNSS (Global Navigation Satellite System) signal. The latter motivated the development of new localization strategies that use the environment information to localize the machinery and thus fulfil the required agricultural task. In this work, the usability of five well known scan matching algorithms as sole localization systems using a 2D LiDAR (Light Detection and Ranging) scanner is tested in an avocado grove. The aim is to show the pros and cons of such techniques when the machinery faces a real agricultural environment: presence of slippage, absence of GNSS signal, non-flat terrains in a non-experimental grove and noisy LiDAR readings. The analysis presented herein concludes with a localization error evaluation when the machinery has to travel through a rough avocado alley, showing that amongst all the techniques implemented, the Probabilistic Iterative Correspondence (PIC) and the Sum of Gaussian Scan Correlation (SGSC) presented the lowest localization estimation error and remained consistent from a localization point of view.



LEONARDO VANZI

Harmanec P., Svanda M., Korcakova D., Chini R., Nasseri A., Yang S., Bozic H., Slecht M., Vanzi L. (2019)
A NEW LOOK INTO PUTATIVE DUPLICITY AND PULSATIONS OF THE BE STAR B CMI
Revista: Astrophysical Journal, Volumen 875, Número 1
Abstract: Bright Be star β CMi has been identified as a nonradial pulsator on the basis of space

photometry with the Microvariability and Oscillations of Stars (MOST) satellite and also as a single-line spectroscopic binary with a period of $170^{d}.4$. The purpose of this study is to re-examine both these findings using numerous electronic spectra from the Dominion Astrophysical Observatory, Ondřejov Observatory, Universitätssterwarte Bochum, archival electronic spectra from several observatories, as well as the original MOST satellite photometry. We measured the radial velocity of the outer wings of the double Hα emission in all spectra at our disposal, and were not able to confirm significant radial-velocity changes. We also discuss the problems related to the detection of very small radial-velocity changes and conclude that while it is still possible that the star is a spectroscopic binary, there is currently no convincing proof of it from the radial-velocity measurements. Wavelet analysis of the MOST photometry shows that there is only one persistent (and perhaps slightly variable) periodicity of $0^{d}.617$ of the light variations, with a double-wave light curve; all other short periods having only transient character. Our suggestion that this dominant period is the star s rotational period agrees with the estimated stellar radius, projected rotational velocity, and with the orbital inclination derived by two teams of investigators. New spectral observations obtained in the whole-night series would be needed to find out whether some possibly real, very small radial-velocity changes cannot, in fact, be due to rapid line-profile changes.Based on spectral observations obtained at the Dominion Astrophysical Observatory, NRC Herzberg, Programs in Astronomy and Astrophysics, National Research Council of Canada, Ondřejov Observatory and Universitätssternwarte Bochum, and on photometry from the Canadian MOST satellite and UBV observations from the Hvar Observatory.

Brahm R., Espinoza N., Jordan A., Henning T., Sarkis P., Jones M.I., Diaz M.R., Jenkins J.S., Vanzi L., Zapata A., Petrovich C., Kossakowski D., Rabus M., Rojas F., Torres P. (2019)

HD 1397B: A TRANSITING WARM GIANT PLANET ORBITING A V = 7.8 MAG SUBGIANT STAR DISCOVERED BY TESS

Revista: Astronomical Journal, Volumen 158, Número 1

Abstract: We report the discovery of a transiting planet first identified as a candidate in Sector 1 of the Transiting Exoplanet Survey Satellite (TESS), and then confirmed with precision radial velocities. HD 1397b has a mass of {M}{{P}} ={0.367}-0.023+0.022 {M}{{J}}, a radius of {R}{{P}}={1.023}-0.013+0.013 {R}{{J}}, and orbits its bright host star (V = 7.8 mag) with an orbital period of 11.5366+/- 0.0003 d on a moderately eccentric orbit (e={0.216}-0.026+0.027). With a mass of {M}star ={1.257}-0.029+0.029 {M}☉ , a radius of {R}star ={2.341}-0.019+0.022 {R}☉ , and an age of 4.46+/- 0.25 Gyr, the solar-metallicity host star has already departed from the main sequence. We find evidence in the radial velocity measurements of a secondary signal with a longer period. We attribute it to the rotational modulation of stellar activity, but a long-term radial velocity monitoring would be necessary to discard if this signal is produced by a second planet in the system. The HD 1397 system is among the brightest ones currently known to host a transiting planet, which will make it possible to perform detailed follow-up observations in order to characterize the properties of giant planets orbiting evolved stars.

Ucci G., Ferrara A., Gallerani S., Pallottini A., Cresci G., Kehrig C., Hunt L.K., Vilchez J.M., Vanzi L. (2019)

THE INTERSTELLAR MEDIUM OF DWARF GALAXIES: NEW INSIGHTS FROM MACHINE LEARNING ANALYSIS OF EMISSION-LINE SPECTRA

Revista : Monthly Notices of the Royal Astronomical Society, Volumen 438, Número 1

Abstract: Dwarf galaxies are ideal laboratories to study the physics of the interstellar medium (ISM). Emission lines have been widely used to this aim. Retrieving the full information encoded in the spectra is therefore essential. This can be efficiently and reliably done using Machine Learning (ML) algorithms. Here, we apply the ML code GAME to MUSE (Multi Unit Spectroscopic Explorer) and PMAS (Potsdam Multi Aperture Spectrophotometer) integral field unit observations of two nearby blue compact galaxies: Henize 2-10 and IZw18. We derive spatially resolved maps of several key ISM physical properties. We find that both galaxies show a remarkably uniform metallicity distribution. Henize 2-10 is a star-forming-dominated galaxy, with a star formation rate (SFR) of about 1.2 M☉ yr-1. Henize 2-10 features dense and dusty (AV up to 5-7 mag) star-forming central sites. We find IZw18 to be very metal-poor (Z = 1/20 Z☉). IZw18 has a strong interstellar radiation field, with a large ionization parameter. We also use models of PopIII stars spectral energy distribution

as a possible ionizing source for the He II λ4686 emission detected in the IZw18 NW component. We find that PopIII stars could provide a significant contribution to the line intensity. The upper limit to the PopIII star formation is 52 per cent of the total IZw18 SFR.

S. Rukdee L. VanziC. SchwabM. FloresA. ValenzuelaJ. PemberA. ZapataK. MotoharaY. YoshiiM. Tala Pinto (2019)
TARdYS: DESIGN AND PROTOTYPE OF AN EXOPLANET HUNTER FOR TAO USING A R6 ECHELLE GRATING
Revista: Experimental Astronomy December 2019, Volume 48, Número 2
Abstract: One limitation in characterizing exoplanet candidates is the availability of infrared, high-resolution spectrographs. An important factor in the scarcity of high precision IR spectrographs is the high cost of these instruments. We present a new optical design, which leads to a cost-effective solution. Our instrument is a high-resolution (R = 60,000) infrared spectrograph with a R6 Echelle grating and an image slicer. We compare the best possible performance of quasi-Littrow and White Pupil setups, and prefer the latter because it achieves higher image quality. The instrument is proposed for the University of Tokyo Atacama Observatory (TAO) 6.5 m telescope in Chile. The Tao Aiuc high Resolution (d) Y band Spectrograph (TARdYS) covers 0.843-1.117 μ m. To reduce the cost, we squeeze 42 spectral orders onto a 1K detector with a semi-cryogenic solution. We obtain excellent resolution even when taking realistic manufacturing and alignment tolerances as well as thermal variations into account. In this paper, we present early results from the prototype of this spectrograph at ambient temperature.

DAVID WATTS

Villalón V., Watts D. and Cienfuegos R. (2019)
ASSESSMENT OF THE POWER POTENTIAL EXTRACTION IN THE CHILEAN CHACAO CHANNEL
Revista: Renewable Energy Volumen 131
Abstract: The feasibility of a tidal plant is assessed by studying the stream velocities, the hydrodynamic impacts and disturbances in the marine environment. However, as these technologies approach a commercial stage, it is important to assess the feasibility of injecting energy into the grid in a cost-effective way. Finding available transmission infrastructure and capacity is now one of the main barriers for renewable energy development.In this paper we assess the power potential of the Chilean Chacao channel and model the power evacuation impacts on the electric grid of the surrounding area in order to assess whether tidal plants in such isolated area are technical and economically feasible. Data obtained from direct measurement and hydrodynamic simulations is used to evaluate the electric power available through one year. The injection of power is simulated using a nested Newton-Raphson power flow solver that gives voltage and power flow changes as the tides evolve considering the characteristics of the grid. We found that a pilot project of 2.4 MW can produce 11.2 GWh per year, injecting in a 23 kV line. The region can integrate 7.4 MW without significant impact. Beyond this capacity, expensive reinforcement along the transmission system is needed.

Pérez Odeh R., Watts D. (2019)
IMPACTS OF WIND AND SOLAR SPATIAL DIVERSIFICATION ON ITS MARKET VALUE: A CASE STUDY OF THE CHILEAN ELECTRICITY MARKET
Revista: Renewable & Sustainable Energy Reviews, Volumen 111
Abstract: Renewable energy is expected to become the main electricity source in the world in the coming decades, with solar and wind power taking a big share of the energy supply. Although there has been a remarkable advance on renewable energy technologies, their integration is still difficult for regulators, market designers and system operators due to the high variability and limited predictability of solar and wind resources. Measures can be adopted to ease their integration, among them geographical diversification. There is plenty of literature about the diversification of solar and wind resources and there is a common conclusion: greater dispersion smooths out power production. However, literature on the effects of spatial

diversification on the power system, electricity prices and renewable energy market value is much scarcer. This paper studies the effects of spatial diversification and questions whether integration policies are incentivizing the placement of renewable generators where they provide the highest value to the electricity system in Chile. Using real data and a simplified dispatch model the analysis presented shows evidence of the effects of diversification on wind and solar market value in Chile. Results suggest that spatial diversification has a strong positive effect on the market value of renewable energy, especially in scenarios with active transmission and hydro-storage constraints. Wind market value may vary up to US$10/MW h depending on the level of diversification and the spatial and temporal constraints of the system and, given current storage capacity of hydro reservoirs, the solar market value may increase US$5/MW h due to diversification if transmission capacity is enough. Even though these results must be observed with caution, because they depend on the assumptions made, there is an important effect of renewable spatial diversification that should be observed by regulators.

Sun C., Mi Z., Ren H., Jing Z., Lu J., Watts D. (2019)
MULTI-DIMENSIONAL INDEXES FOR THE SUSTAINABILITY EVALUATION OF AN ACTIVE DISTRIBUTION NETWORK
Revista: Energies, Volumen 12, Número 3
Abstract: An active distribution network (ADN) differs from a traditional distribution network in many aspects, one of which is the integration of a large amount of distributed generation (DG), especially intermittent photovoltaics (PVs). The integration of intermittent PVs has both pros and cons for the distribution system. As the platform on which new techniques work and the main body of a greener future energy system, the development of an ADN has to be sustainable, need-oriented, and environmentally friendly, and the traditional technical–economic evaluation method cannot meet the requirements and provide advice in the decision-making process. Based on the concept of sustainable development, we used an ADN with the integration of a large number of distributed PVs (DGPVs) as an example and established a multi-dimensional index system to evaluate the sustainable development level (SDI) of the ADN. The analysis was based on a platform we built with consideration of the investment feasibility of the DGPVs' investors, state and industrial policies, and their interactions with the distribution system. We first compared the development of DGPVs and the SDI of the ADN as the carrier of DGPVs under different state policies, and second, we compared the SDIs of three city ADNs with different solar resources and demand levels, but under the same state policy. The analysis results showed that different integration levels of DGPVs can be set for a city/area ADN with different solar resources and demand to achieve a comparable SDI, and a comprehensive incentive mechanism could be adopted for the development of DGPVs. In this way, the benefits of different parties can be considered at the same time and finally, the coordination of the sustainable development of multi-parties can be achieved.

Avilés C., Oliva S., Watts D. (2019)
SINGLE-DWELLING AND COMMUNITY RENEWABLE MICROGRIDS: OPTIMAL SIZING AND ENERGY MANAGEMENT FOR NEW BUSINESS MODELS
Revista : Applied Energy, Volumen 254
Abstract: Grid-connected microgrids (MG) can offer significant benefits to electricity systems by improving the security of energy supply with clean renewable energy sources. Unlocking these benefits requires designing suitable business models that can capture the value of MGs and that help removing barriers to their uptake. In this work, we evaluate the profitability and self-sufficiency of optimally designed MGs for new proposed business models. The business models are tested in seventeen different geographical locations which offer a vast diversity of renewable resources, seasonal climatic variability and electricity tariffs. Both Net Billing and Net Metering schemes are tested, for both single-dwelling and community residential customers. Electricity tariffs include both energy volumetric and peak demand charges. We model the optimal sizing and energy management of the MGs by minimizing the total customer electricity costs. The generation mix of the MGs is the result of a bilevel optimization which take into account renewable resources and costs, diesel prices and tariffs. MGs can potentially be comprised by solar PV, wind and diesel generation, together with battery storage systems and demand response resources. We find significant levels of self-sufficiency based on solar sources across the country, and also wind power in some specific locations. The community business model, case

which includes the peak demand charges, is generally more profitable than the case of single-dwellings. This shows that the MGs are effective at reducing the peak demand charge of a residential electricity bill. We therefore recommend the further promotion of community energy arrangements as a key way to improve the current very slow uptake of distributed generation in developing countries.

Bustos C., Watts D., Olivares D. (2019)

THE EVOLUTION OVER TIME OF DISTRIBUTED ENERGY RESOURCE'S PENETRATION: A ROBUST FRAMEWORK TO ASSESS THE FUTURE IMPACT OF PROSUMAGE UNDER DIFFERENT TARIFF DESIGNS

Revista : Applied Energy, Volumen 256

Abstract: In the future, drastic cost reductions of Distributed Energy Resources will probably drive their deployment without the need of economic incentives – especially photovoltaic energy. Dynamic Grid Parity Models combine learning curves with grid-parity. They are the state-of-the-art solution to assess the time-evolving competitiveness of generation technologies, but fail to capture the residential end-user's choices of installing Distributed Energy Resources once they become feasible. We propose a robust framework based on a local and optimal microgrid combined with learning curves to assess the potential penetration of Distributed Energy Resources in households. This framework adds a notably richer interaction between the elements of the distribution system, e.g., optimal dispatch or peak shaving. We quantify the time-evolution of residential end-user's bills and the utility's revenue, applied to four tariff designs. Today Chile pioneers a massive deployment of photovoltaic systems without incentives, becoming a unique example worldwide, specially the so called "Solar City of Diego de Almagro", a town with a remarkable solar resource and massive PV deployment, chosen as the case study. Results show PV dominance with flat bundled volumetric tariffs and the increase of utility's bankruptcy risk if tariffs are not updated (47% revenue reduction). If updated, bills would increase 24%, affecting non-owners. A two-part tariff overcomes this but it is regressive and it delays PV deployment. A three-part tariff improves efficiency and introduces prosumage, with a small peak-shaving effect. Owners could face regulatory risks due to possible tariff design changes. This study lays the foundation for future rate cases, and for distribution and transmission planning.

Maeda M., Watts D. (2019)

THE UNNOTICED IMPACT OF LONG-TERM COST INFORMATION ON WIND FARMS' ECONOMIC VALUE IN THE USA. – A REAL OPTION ANALYSIS

Revista: Applied Energy, Volumen 241

Abstract: Renewable energies are a natural replacement for conventional or fossil fuel energy generation. One of these sources, wind energy, has exhibited significant cost reductions during the last decades. Even though this historical cost reduction trend is well known in the industry and in the academia, information on this cost trend and volatility has been scarcely incorporated in previous works, thus a natural concern arises when assessing their influence on the economic valuation of wind farms. Moreover, wind projects are modular in size and have a short time-to-market, providing a valuable managerial flexibility to defer investment under non-attractive market conditions, such as high development cost scenarios. Traditional evaluation tools often consider those scenarios, wrongly assuming that wind-developers would move forward with the project under such conditions. Accordingly, this paper analyzes the effect of incorporating both generation cost history and investment flexibility in the valuation of wind farms in the United States using Real Options methodology. Taking two decades of cost data and a reference wind farm, this "uncertainty-flexibility" effect is incorporated and valued, finding that the value of the wind project is 14.2% larger than the one neglecting such effect – where cost stochasticity and managerial flexibility are ignored. Therefore, traditional tools for project valuation, such as discounted cash flow and scenario analysis can no longer solely be used, as they do not properly account for the cost reduction trend, uncertainty, and managerial flexibility that a wind farm could face.Keywords: Levelized cost of energy; Wind energy; Managerial flexibilities; Deferring investment; Renewable energy; Real option

V. PROYECTOS DE INVESTIGACION

“Cardiovascular MR function: new insights from intracardiac flows and strain analysis” FONDECYT 1181057. 2018-2022.
Investigador responsable: Marcelo Andia Co- investigadores: Sergio Uribe

"Understanding the relationship between venous thrombosis and atherosclerosis: the monocyte link" Fondecyt Regular 1180525. 2018-2022.
Investigador responsable: Marcelo Andia Co- investigadores: Sergio Uribe

“Núcleo Milenio en Resonancia Magnética Cardiovascular” 2018-2021.
Asociados Director: Sergio Uribe co.-Director: Marcelo Andía Senior: Pablo Irarrazaval Adjuntos: Cristián Tejos

"Magnetic resonance fingerprinting: technical developments and clinical applications" Redes 180090. 2018-2019.
Investigador Asociado: Marcelo Andía

“Dispositivo de espectroscopia de infrarojo cercano para el registro no invasivo de la respuesta neurovascular de la médula espinal gatillado por estimulación periférica“ FONDEF IDeA ID18I10064. 2018-2020.
Director: Sergio Uribe

“Multi-sequence MRI characterisation of deep vein thrombosis in man”. British Heart Foundation, BHF15/89/31793. Division of Imaging Sciences, King's College London, UK. 2016–2019.
Colaborador Internacional: Marcelo Andía

Aceleración y Validación de adquisiciones de datos de 4D flow obtenidos por resonancia magnética cardiovascular. FONDECYT. 2017 – 2020
Investigador Patrocinante: Pablo Irarrázaval

Free breathing 3D Cardiac Multiparametric Magnetic Resonance Fingerprinting. FONDECYT. 2016 - 2020
Investigador Responsable: Claudia Prieto Coinvestigador: Pablo Irarrázaval

Identifying systemic, cellular and molecular features of metabolically normal and abnormal overweight/obesity. FONDECYT. 2017 - 2020
Coinvestigador: Pablo Irarrázaval
Improving Quantitative Susceptibility Mapping reconstruction methods based on MRI acquisitions. FONDECYT. 2016 - 2019
Investigador Responsable: Cristián Tejos

Multiscale Inversion of Porous Rock Physics using High-Perfomance Simulator: Bridging the Gap between Mathematics and Geophysics (MATHROCKS). Horizonte 2020, Internacional. 2017 – 2021
Investigador Asociado: Carlos Jerez

"Sonification of medical data". FONDECYT 1161328 2016–2019. Investigador Principal: Rodrigo Cádiz
Co-Investigador: Marcelo Andía

Uncertainty Quantification and Advanced Boundary Element Methods for Electromagnetic Wave Scattering Problems. FONDECYT. 2017 - 2020
Investigador Responsable: Carlos Jerez

High-Performance Computing for Multiple Traces Formulation. PCI. 2016-2019 Investigador responsible: CarlosJerez

Advanced Research in Adaptive Optics for Extremely Large Telescopes. FONDECYT. 2015 - 2019
Investigador Responsable: Christian Dani Guzmán

Cutting-edge Exoplanetary Science Using the First Generation of Chilean-funded Astronomical Optical Instrumentation. FONDECYT. 2018 – 2021
Patrocinante: Leonardo Vanzi

Enhancing motion perfomance of automated machinery in agricultural environments based on bayesian estimation approaches . FONDECYT. 2017 - 2020
Coinvestigador: Miguel Torres

Point Spread function Reconstruction in Tomographic Adaptative Optics. FONDECYT. 2016 - 2019
Investigador Responsable: Andrés Guesalaga

The Tao Aiuc high Resolution Y band Spectrograph – TARdYS. ASTRONOMIA. 2017 - 2020 Investigador Asociado: Leonardo Vanzi

Neutrino Astrophysics in Chile. ASTRONOMIA 2017-2020 Investigador asociado: Angel Abusleme.

Agent-Based Modeling and Simulation for Energy Markets. PCI. 2018-2019 Investigador responsable: Alvaro Lorca
Investigador Asociado: Matías Negrete; Daniel Olivares

Centro de Investigación en Energía Solar SERC-Chile. FONDAP. 2017-2022 Investigador Asociado: Alvaro Lorca, David Watts
Investigador: Matías Negrete, Daniel Olivares

Communication and Information Research and Innovation Center (CIRIC-CHILE). Innova. 2012-2022
Investigador asociado: Sebastián Ríos

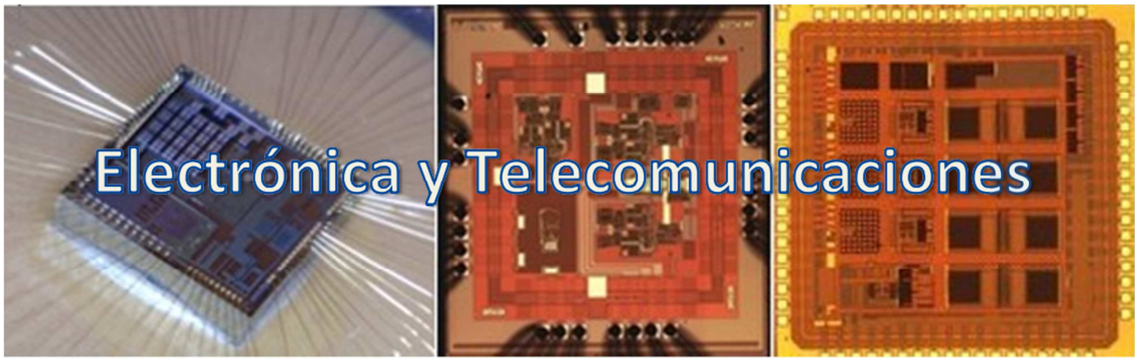
Diseño e implementación de infraestructura tecnológica para la gestión efectiva de consumos flexibles en sistemas eléctricos. FONDEF. 2018-2020
Director: Matías Negrete Subdirector: Daniel Olivares
Investigador: Alvaro Lorca, Christian Oberli

International Center for Excellence in Solar Energy / Centro de Tecnologías para Energía Solar de Fraunhofer Chile Research (FCR-CSET). INNOVA. 2014-2023
Investigador asociado: Daniel Olivares, David Watts, Matías Negrete

Local Energy Markets for Sustainable Microgrids: Design, Modeling and Simulation. FONDECYT. 2018-2021
Investigador responsible: Daniel Olivares Coinvestigador: Alvaro Lorca, Matías Negrete

Optimization under Uncertainty for Power System Resilience FONDECYT. 2017-2020 Investigador responsible: Alvaro Lorca

Risk Renewable Energy and Complementarity: Closing the GAP Between Portfolio Theory and Power System Planning FONDECYT. 2018-2021
Investigador responsible: David Watts Coinvestigador: Hugh Rudnick, Matías Negrete



Characterizing patterns of spatio-temporal variability in snow properties trough field and remotely sensed observations. FONDECYT. 2017-2020
Coinvestigador: Christian Oberli

Effects of consumer behavior on agglomeration of competitive facilities. FONDECYT. 2016-2019.
Investigador responsible: Vladimir Marianov

Experimental Particle Physics with Daya Bay, JUNO and ATLAS. FONDECYT. 2018-2021 Coinvestigador: Angel Abusleme

Experimental Particle Physics with Daya Bay, JUNO and ATLAS. FONDECYT. 2018-2021 Coinvestigador: Angel Abusleme

Instituto Sistemas Complejos de Ingeniería (ISCI). PIA. 2014-2019 Subdirector: Vladimir Marianov
Investigador asociado: Daniel Olivares, Matías Negrete

Modular Integrated circuits desing and its application in instrumentation circuits for particle physics experiments. FONDECYT. 2017-2021 Investigador responsible: Angel Abusleme

Distributed Multi-Agent Control for the Internet of Things. FONDECYT. 2016-2019
Investigador responsible: Felipe Núñez

Enhancing motion perfomance of automated machinery in agricultural environments based on bayesian estimation approaches. FONDECYT. 2017-2020
Coinvestigador: Miguel Torres

Sistema de Análisis de Big Data en Refinerías Electrolíticas para el Mejoramiento de la Automatización y Gestión Operacional: caso Chuquicamata. FONDEF. 2017-2020 Director: Aldo Cipriano
Subdirector: Felipe Núñez

VI. ACTIVIDADES INTERNAS Y DE DIFUSION

Semana de la Ingeniería Eléctrica

En Octubre del 2019 se realizó la “Semana de la Ingeniería Eléctrica”, una semana que contó con interesantes exposiciones de invitados externos y además los profesores del Departamento dieron a conocer sus áreas de investigación y los proyectos en los que se encuentran trabajando

Seminario DIE

Con gran participación de profesores y alumnos se realizó el 15 de Marzo el Seminario DIE, el objetivo dar a conocer algunos de los temas de investigación y crear una instancia para la búsqueda de oportunidades de investigación.

Invitados Externos

Profesores, Ingenieros de Chile y el extranjeros visitaron nuestro Departamento y dieron a conocer de sus investigaciones

Ingeniero Eléctrico Tomás Opazo del Air Vehicle Intelligence and Autonomy Laboratory. (Junio 2019)

Profesor Patrick Fay, del Departament of Electrical Engineering, University of Notre Dame. (Mayo 2019)

Profesor José Rodríguez, Premio Nacional en Ciencias Aplicadas y Tecnológicas 2014 (Mayo 2019)

Magíster y Doctor en Física del Instituto Weizmann de Israel, Jorge Mikenberg (26 Abril 2019)

Profesor Fabián Vargas, decano del programa de postgrado de ingeniería eléctrica en la Pontifícia Universidade Católica do Rio Grande do Sul, PUCRS, Brasil (Marzo 2019)

Charlas de Postgrado

Durante el 2019 se realizó Ciclos de Charlas de los Alumnos de Postgrado, una instancia de comunicación al interior de nuestro Departamento, para mantener un feedback entre lo que se está investigando en cada área. Este año se realizaron 11 charlas y la asistencia de alumnos llegó a 229.