Informe Productividad 2017
DIE-UC

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INTRODUCCION

Durante el año 2017, 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 2017.

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.
- Publicaciones en revistas ISI.
- Otras publicaciones.
- Proyectos de investigación desarrollados.
- Acreditaciones
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I. TESISTAS GRADUADOS DEL PROGRAMA DE DOCTORADO EN CIENCIAS DE LA INGENIERIA

Arrieta Pellegrin, Cristóbal Ignacio.
Tesista: Tesis: "Prior Knowledge for level set segmentations".
Supervisor: Cristián Tejos
Fecha de la defensa: 28-08-2017
Resumen:
Los avances en imagenología han permitido tener imágenes anatómicas de mejor calidad. Existen técnicas computacionales que ayudan a extraer de estas imágenes, información relevante para el diagnóstico. Por ejemplo, la segmentación, que consiste en separar un objeto de interés de otros múltiples objetos. La segmentación es un gran desafío, pues la información visual no es suficiente para segmentar correctamente algunas estructuras. Los médicos compensan la información faltante con sus conocimientos de anatomía. Las técnicas computacionales pueden incorporar esa información anatómica. Se propone dos métodos para agregar conocimiento acerca de la forma de objetos específicos al proceso de segmentación. El primer método agrega restricciones geométricas simples, y fue diseñado específicamente para segmentar simultáneamente los ventrículos izquierdo y derecho del corazón a partir de imágenes de resonancia magnética. Este método mostró un alto nivel de precisión comparado con segmentaciones manuales, realizadas por expertos. El segundo método agrega información estadística generada a partir de un conjunto de formas de entrenamiento, y fue aplicado satisfactoriamente en un amplio rango de imágenes desafiantes, incluyendo múltiples aplicaciones en resonancia magnética. Estos métodos son un aporte a la automatización de procesos necesarios para el diagnóstico médico y abren posibilidades para generar mediciones cuantitativas más precisas, más consistentes y con mayor detalle que las usadas actualmente.

Tesista: Bustos Sölch, Cristian Pablo.
Tesis: "The paradign shift for residential end-users of electricity due to renewable energy penetration".
Supervisor: David Watts
Fecha de la defensa: 27-07-2017
Resumen:
El principal método de diagnóstico de la esteatosis hepática es la biopsia, procedimiento invasivo y riesgoso con problemas de muestreo. Por esta razón, es necesario un método de cuantificación no invasivo y global. No toda la grasa acumulada en los tejidos tiene las mismas características físicas ni biológicas. Por lo tanto no solo es necesario avanzar en una mejor cuantificación de la grasa total, sino también en su caracterización no-invasiva. Existen métodos de cuantificación de grasa con imágenes de resonancia magnética, pero en general obtienen resultados imprecisos. En este trabajo se proponen algunas formas de medir la cantidad de grasa en el hígado utilizando métodos indirectos, como la hipertensión portal intrahepática, y la espectroscopía para caracterizar la presencia de ácidos grasos en un elemento

volumétrico. El objetivo es caracterizar la grasa por medio de sus metabolitos, y usando un algoritmo de optimización, estimar qué tipo de ácidos grasos la conforman, con el fin de modelar el estado de la grasa y clasificarlo como normal, esteatosis hepática o esteatohepatitis.
En etapas posteriores se podrá aplicar el método de caracterización de ácidos grasos propuesto, en imágenes tridimensionales, con el objetivo de conocer la distribución de grasa en todos los lóbulos del hígado.

Tesista: Marambio Granic, Rodrigo Eduardo.
Tesis: "Improved Market Representation of agent preferences in a renewable environment".
Supervisor: Hugh Rudnick
Fecha de la defensa: 17-08-2017
Resumen:
El contexto dado por la creciente inclusión de energías renovables intermitentes e inciertas en los sistemas eléctricos, presenta desafíos tanto operacionales como regulatorios. Algunas dimensiones de los agentes involucrados no están siendo plenamente representadas por mecanismos de mercado existentes. El objetivo de la investigación es diseñar mecanismos para el sector generación, que permitan mejorar condiciones en las áreas de energía, capacidad y seguridad, a través de una mejor representación de las preferencias de los agentes participantes. En el área de energía, un diseño de subasta de energía de largo plazo, con una representación del perfil de corto plazo de los participantes a la hora de adjudicar la subasta. En el área de capacidad, un mercado de capacidad, cuya curva de demanda considera tanto las estadísticas de las centrales renovables como las preferencias de la demanda. En seguridad, un mecanismo para determinar el volumen sistémico óptimo de Gas Natural Licuado a importar sobre la base de un mercado de cobertura de riesgo, con el fin de disponer del volumen necesario de dicho combustible. En todos se obtiene un beneficio en comparación con mecanismos existentes, concluyéndose que a través de una mejor representación de las preferencias de los agentes, es posible reducir el riesgo y mejorar la asignación de recursos.

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

Tesista: Avilés Arias, Camilo Maximiliano.
Tesis: "Evaluating community and single-dwelling renewable Micro Grids in Chile: Energy management and optimal sizing for different business models".
Supervisor: David Watts.
Fecha de la defensa: 25-04-2017.
Resumen:
This research examines renewable micro grids that incorporate optimal sizing and energy management to reduce supply costs for different Chilean and international business models. From that perspective, household or community micro grids, either connected or unconnected to an upstream network, can be measured through a mix of distributed energy resources, including renewable sources such as solar and wind generation, diesel generators, battery storage systems and efficient demand management. Regulated rates are assessed for grid-connected micro grids, which include community demand and energy charges as well as single-dwelling charges. Net-Billing and Net-Metering schemes are evaluated for both household and community micro grids.

Tesista: Dauvin Gutiérrez, Louise Chantal,
Tesis: "Optimization of temperature, targets, and illumination for high precision photogrammetric camera calibration".
Supervisor: Leonardo Vanzi.
Fecha de la defensa: 19-06-2017.
Resumen:
MOONS, Multi-Object Optical and Near-Infrared Spectrograph, será un instrumento para uno de los telescopios de 8.2 m del Very Large Telescope de ESO. Este estudiará el espectro de 1000 objetos celestes en un campo de vista de 500 arcmin². Para ello ubicará micrometricamente un conjunto de fibras ópticas sobre la imagen de dichos objetos. El movimiento de las Unidades Posicionadoras de Fibra y el cálculo de sus posiciones deben tener un error menor a 15 um. Este cálculo se realizará con un sistema de metrología basado en la técnica de fotogrametría. La fotogrametría de rango cercano mide espacialmente objetos cercanos con cámaras digitales. Por ello, ellas deben calibrarse en términos de su posición y propiedades ópticas, lo que es crucial para el funcionamiento del sistema completo, más aún si se requiere precisión micrométrica. Por lo tanto, la calibración de cámaras debe desarrollarse en condiciones óptimas. En esta investigación, el efecto de las variaciones de temperatura debido al calentamiento inicial de las cámaras, fue estimado como 0.1 pix de movimiento en las posiciones de los targets en las imágenes. Este efecto se redujo a 0.02 pix, al igual que el tiempo de calentamiento de las cámaras, que pasó de más de 20 minutos a menos de 10 minutos. Además, se estudió que una variación de 20% en la intensidad de la iluminación produce una diferencia de dispersión de medición de 0.008 pix. Asimismo se concluyó que 180° de variación angular de la iluminación y las cámaras produce variaciones de 0.3 pix con el

uso de targets retroreflectantes. Por el contrario, estas variaciones se reducen ~10 veces con targets opacos de mayor tamaño.

Tesista: González Troncoso, Rodrigo Adolfo.
Tesis: "Detección y estimación de ingestas para control predictivo de páncreas artificial en pacientes con T1DM".
Supervisor: Aldo Cipriano.
Fecha de la defensa: 23-01-2017.
Resumen:
La diabetes mellitus tipo 1 es una enfermedad crónica cuya prevalencia aumenta anualmente en la población chilena. Su tratamiento más avanzado es a través de infusión de insulina mediante sistemas de páncreas artificial, no obstante, estos no funcionan en forma automatizada pues necesitan del paciente para informar ingestas, entre otros datos y eventos. Así, el objetivo de esta tesis es el diseño de un algoritmo de páncreas artificial capaz de detectar eventos de ingesta, estimar y predecir la glucosa absorbida e incorporar estos elementos en una terapia de infusión autónoma. Para ello, el algoritmo propuesto cuenta con un identificador adaptivo de la dinámica de glucosa e insulina del paciente a través de datos de entrada-salida del sistema y un observador que detecta ingestas y estima en tiempo real su absorción de glucosa asociada. Luego, se ajusta un modelo de absorción, a partir de las estimaciones, que se incorpora en una ley de control predictivo. Así, se obtiene un sistema que no requiere calibración para cada usuario ni su intervención para notificar ingestas y, adicionalmente, permite dejar en evidencia la mejora del desempeño de un control de infusión autónoma producto de la utilización de información inferida sobre la alimentación del paciente. Pruebas in silico de lazo abierto del algoritmo mostraron un retardo de 3 muestras al detectar ingestas, un mínimo en el estado del arte, y alto ajuste de las estimaciones y predicciones al proceso de absorción. Asimismo, se obtuvo una mejora en lazo cerrado respecto del control predictivo clásico al reducir el tiempo de estabilización en un 60% a menos de 3,5 horas y eliminar sobredosis de insulina que provocan hipoglucemia. Aun así, no se logró evitar hiperglucemias tras la ingesta pues las predicciones carecen de precisión en el corto plazo y, por ello, se propone incluir técnicas heurísticas para complementar las leyes de control de terapias de insulina. En suma, se probó la posibilidad de automatizar páncreas artificiales para rechazar ingestas, y se diseñó un algoritmo que provee nueva información para refinar el tratamiento en lazo cerrado de la diabetes. Sin embargo, aún resta validar su robustez en aplicaciones in vivo.

Tesista: Maluenda Philippi, Benjamín
Tesis: "Expansion Planning Under Long-Term Uncertainty for Hydrothermal Systems with Volatile Resources"
Supervisor: Daniel Olivares; Matías Negrete
Fecha de la defensa: 11-05-2017
Resumen:
The significant integration of volatile renewable energy sources in power systems has raised concerns that motivate the use of greater operational details in expansion planning. Economic and reliable investment plans in this new paradigm can be obtained through the development of improved tools for electricity generation and transmission infrastructure planning.

In this regard, this work proposes a stochastic programming model for planning the expansion of hydrothermal power systems. The model considers representative days with high temporal resolution and uncertainty in water inflows. This allows to capture inter-hourly phenomena such as load and renewable profile chronologies, ramping constraints and energy storage management. In addition, multiple long-term scenarios in the investment scale are included to obtain investment plans that yield reliable operations under extreme conditions. The Progressive Hedging Algorithm is applied to decompose the problem on a long-term scenario basis and to use computational resources efficiently.
Numerical experiments on the Chilean power system show that the use of representative days outperforms the use of load blocks in both cost and reliability metrics. Results also show that reservoir hydroelectric plants provide higher flexibility to the system, enabling an economic and reliable integration of volatile and intermittent resources. Experiments also illustrate the impacts of considering extreme long-term scenarios in the obtained investment plans.

Tesista: Ortega Soto, Javiera Constanza
Tesis: "Unit Commitment Estocástico con Restricciones de Transmisión: Chile frente a un escenario de alta penetración eólica y solar"
Supervisor: David Watts
Fecha de la defensa: 31-10-2017.
Resumen:
El constante crecimiento de la generación eólica y solar ha producido que los operadores de los sistemas eléctricos deban enfrentar mayores desafíos para poder mantener sus operaciones seguras en todo momento. La cuantificación de las reservas operacionales, en este sentido, toma un rol muy importante debido a que este tipo de reservas corresponde a recursos de generación, u otros, que se encuentran listos para responder en caso de una contingencia. Esta investigación presenta una revisión de los tipos de reservas operacionales utilizadas en los sistemas eléctricos para compensar las fluctuaciones en la demanda y la generación, con el objetivo de mantener el balance entre ellos en todo momento. Este estudio incluye: (1) una revisión del concepto de reservas operacionales, (2) una revisión de las metodologías utilizadas por los mercados alrededor del mundo para incluir la evaluación de las reservas operacionales en el Day-Ahead Unit Commitment (mercado del día anterior) y (3) una comparación entre la aplicación del modelo estocástico y determinístico a los sistemas eléctricos chilenos.
El objetivo de esta investigación es comparar las diferentes metodologías de Unit Commitment para determinar cuál de ellas representaría una herramienta adecuada para la evaluación de las reservas operacionales en un mercado eléctrico real, como el caso de Chile. La conclusión principal que se extrae es que la evaluación estocástica de las reservas operacionales, mediante programación estocástica o evaluación de diversos escenarios bajo un enfoque determinístico, es la alternativa más apropiada bajo gran presencia de generación renovable, ya que aumenta la exactitud de las soluciones, mejorando el rendimiento del sistema cuando el recurso renovable varía. La desventaja de esta opción es el mayor tiempo de resolución que significa, por lo que se recomienda utilizar técnicas de reducción de escenarios para su aplicación, con el objetivo de mejorar su rendimiento computacional.

Tesista: Paredes Lizama, Fabián Tomás.
Tesis: "Diseño y optimización de landmarks para localización en túneles".
Supervisor: Miguel Torres.
Fecha de la defensa: 10-04-2017.
Resumen:
La minería es una de las actividades económicas más importantes del país, y es de interés general automatizar sus distintos procesos para mejorar la seguridad de los trabajadores, aumentar la productividad y reducir los costos de mantención de los vehículos utilizados. Es de especial interés automatizar los procesos de explotación de mineral de galerías subterráneas donde se han implementado distintos procesos parcialmente automatizados mejorando la seguridad de los operadores y reduciendo el desgaste de los vehículos. Uno de los problemas a resolver para lograr la automatización total es localizar al vehículo de forma correcta dentro del escenario de operación para lo cual se han desarrollado numerosos métodos. Sin embargo, no se ha logrado encontrar un buen método de estimación de la localización cuando se recorren túneles rectos homogéneos ya que los métodos convencionales utilizan una infraestructura activa que requiere mantención o requieren de características distintivas del entorno. En este trabajo se implementa un método para encontrar landmarks pasivos volumétricos optimizados y con los parámetros de diseño que mejoran su rendimiento en algoritmos de estimación de posición, junto con dos algoritmos de estimación de la posición relativa del vehículo basados en mediciones de LIDAR de landmarks pasivos volumétricos colocados con anterioridad a lo largo de un túnel recto y homogéneo combinado con sus señales de control. Los algoritmos de estimación se basan en localizar los landmarks a lo largo del túnel con técnicas de matching de modelos a las mediciones, donde ambos algoritmos se diferencian en la utilización de ICP (Iterative Closest Point) con distancia euclidiana punto a punto o una transformaciones rígidas iterativas con distancia de Hausdorff para realizar este calce. Se pudo calcular que los algoritmos exitosamente permiten estimar la posición dependiendo de los landmarks utilizados.
Los landmarks optimizados se encontraron mediante un proceso de optimización genética para el cual se utilizaron dos genomas, uno que asume una forma básica y otro que define su forma en sus genes. Con los resultados de las simulaciones se pudo obtener que la forma no altera el desempeño del algoritmo, mientras que sus dimensiones y el espacio entre ellos determina el desempeño en cada caso. El algoritmo de localización relativa fue evaluado en una plataforma skid-steer industrial adaptada para una operación semiautónoma en un escenario artificial que replica las condiciones sensoriales encontradas en un túnel minero. De esta manera se pudo validar exitosamente el desempeño de los landmarks optimizados.

Tesista: Pickenpack Morales, Felipe Salvador.
Tesis: "Robotics-related activities designed to improve stem skills of early primary school children".
Supervisor: Miguel Torres.
Fecha de la defensa: 02-08-2017.
Abstract:
More than half of the Chilean students do not have the basic skills in mathematics, according to standardized national (SIMCE) and international (PISA and TIMSS) tests. This fact has raised the need of finding effective learning activities for disadvantage students, specially at early grades to reduce the learning gap. In this project, we present a set of eleven robotics-based activities for early primary school students, that were conceived to improve the logical-mathematical, visuospatial and problem-solving skills, fundamental for STEM subjects. These

activities were implemented for testing and improving at a school with a high socio-economical vulnerability index, through a school year and involved 72 first and second grade students. To measure the methodology's effect, a subset of three activities, focused on the development of logical-mathematical skills through programming of robotic devices, were selected and an aligned evaluation instrument was
developed. These programming activities were carried out through a focused intervention with 25 students from third grade and the instrument was pre- and post applied to measure the effect. On both interventions, students were able to fully complete the tasks and achieve most of the learning objectives regardless of the students' grade. Furthermore, we found a statistical difference between the pre and post test scores ($t(13)=-5.610$, $p < 0.0001$). This significant effect of the activities on the children's abilities provides the basis for future longitudinal studies on the impact of the robotics-based activities in the development of STEM skills in early primary school children.

Tesista: Valenzuela Meza, Alan Bastián.
Tesis: "Long-Term Power Systems Planning with Operational Flexibility"
Supervisor: Matías Negrete, Daniel Olivares
Fecha de la defensa: 17-08-2017
Resumen:
En los últimos años, la energía renovable ha alcanzado niveles de penetración sin precedentes en los sistemas de potencia. Dado que varios países se han propuesto ambiciosas metas futuras, se espera que la inclusión de estas fuentes aumente. Esta inclusión ha llamado la atención sobre los desafíos operacionales relacionados con su carácter volátil. En este ámbito, el concepto de flexibilidad -la capacidad de los sistemas de energía para reaccionar a cambios repentinos en la demanda y la suministro- pasa a ser clave. Aunque se han hecho avances significativos para mejorar la modelación de la flexibilidad de los sistemas de potencia en la operación, este problema generalmente se descuida en los modelos de planificación de la expansión, debido a problemas computacionales. Para abordar estos problemas, este trabajo presenta un modelo de planificación de expansión de generación y transmisión de sistemas de potencia manejable que permite obtener un mix de capacidad casi óptimo, considerando penetración renovable con operación detallada. Esto se logra al considerar una relajación de las restricciones de pre-despacho (UC) para hacer el problema computacionalmente tratable en la práctica, mientras se toma en cuenta los requisitos de flexibilidad operacional. La formulación propuesta se compara en términos de optimalidad y tiempo de resolución con dos modelos de referencia: un modelo de planificación con representación exacta de UC y otro en el que no se consideran las restricciones de UC. Los resultados muestran que la formulación propuesta es capaz de representar la flexibilidad operacional en las decisiones de planificación, con tiempos de resolución reducidos.

Tesista: Velásquez Guerino, Constantin Sebastián.
Tesis: "Robust and Efficient Decision Making for Transmission Expansion Planning under Uncertainty".
Supervisor: Hugh Rudnick.
Fecha de la defensa: 25-01-2017.
Resumen:

Transmission Expansion Planning (TEP) is a complex problem faced with a myriad of uncertainties ranging from fuel prices to earthquakes and public opposition. To date, no systematic analysis has been developed for the different underlying uncertainties in TEP. Moreover, the debate on planning methodologies for coping with long term uncertainties captured by strategic scenarios lacks completeness. Indeed, whilst advocates of stochastic programming ignore the unavailability of precise probabilities in practice, opponents rely on alternative criterions such as minimax regret without verifying solution efficiency.
Therefore, this thesis attempts a fourfold contribution to the literature. First, develop a conceptual framework for researchers, policy and practitioners to better understand and communicate the various uncertainties and risks relevant to TEP. Second, quantify the practical relevance and impact of ambiguous scenario probabilities in stochastic TEP. Third, present a novel distributional robust decision-making criterion for TEP under ambiguity. Fourth, compare the optimal solution under alternative TEP decision-making criterions such as expected cost, minimax regret and distributional robustness, by both theory and simulation based on the well-established concept of Pareto efficiency.
The developed methodology is applied to the IEEE 24 bus RTS system under two scenarios. In this example, stochastic TEP is relatively insensitive to variations in scenario probabilities. However, it also ignores many efficient solutions in the concave Pareto frontier. Although minimax regret can discover such solutions, it is proved that myopic minimax regret methodologies (with respect to Pareto efficiency) such as those applied in UK, PJM and Chile can incur in gratuitous opportunity losses of as much as 4% of total system costs. Further analyses of large-scale systems under more scenarios are needed in order to provide robust insights to identify strengths and weaknesses of both methods.

Tesista: Villanueva Casado, Constanza Javiera.
Tesis: "Open design of an actuated arm orthosis using 3D printing technology for patients with progressive muscular dystrophy".
Supervisor: Miguel Torres.
Fecha de la defensa: 27-11-2017.
Resumen:
Los pacientes con distrofia muscular progresiva (DMP) no son capaces de realizar actividades cotidianas por su propia cuenta. Las órtesis de brazo los ayudan a realizar tareas sencillas y de esta manera tratar de mejorar su calidad de vida. Sin embargo, el costo y usabilidad de las órtesis comerciales existentes las hace prohibitivas para muchas personas. Por lo tanto, este trabajo propone diseñar una órtesis con actuadores, que se fabrica empleando la cada vez más popular tecnología de impresión 3D. La órtesis tiene tres articulaciones pasivas y una articulación actuada. Este documento presenta una revisión completa del diseño del mecanismo, así como la evaluación experimental del dispositivo. Los resultados muestran que la órtesis ayuda a los pacientes a completar actividades que requerirían la compensación corporal de la postura de no contar con la órtesis. Un sistema de órtesis con actuador de bajo costo solo puede apoyar el movimiento articular de pacientes que mantengan una cierta fuerza mínima, particularmente en el hombro, y no hayan perdido la movilidad completa del brazo. Pacientes con una degeneración muscular más avanzada requerirían una órtesis similar, pero con actuadores de mayor toque, y por lo tanto de mayor costo.

III. PUBLICACIONES EN REVISTAS ISI

Abramowicz H., Abusleme A., Afanaciev K., Alipour Tehrani N., Balázs C., Benhammou Y., Benoit M., Bilki B., Blaising J-J., Boland M.J., Boronat M., Borysov O., Bo ovic-Jelisavcic I., Buckland M., Bugiel S., Burrows P.N., Charles T.K. and Daniluk W.(2017) Higgs physics at the CLIC electron–positron linear collider. European Physical Journal, C 77 41p.

Abstract:
The Compact Linear Collider (CLIC) is an option for a future e+e- collider operating at centre-of-mass energies up to 3 TeV, providing sensitivity to a wide range of new physics phenomena and precision physics measurements at the energy frontier. This paper is the first comprehensive presentation of the Higgs physics reach of CLIC operating at three energy stages: sqrt(s) = 350 GeV, 1.4 TeV and 3 TeV. The initial stage of operation allows the study of Higgs boson production in Higgsstrahlung (e+e- -> ZH) and WW-fusion (e+e- -> Hnunu), resulting in precise measurements of the production cross sections, the Higgs total decay width Gamma_H, and model-independent determinations of the Higgs couplings. Operation at sqrt(s) > 1 TeV provides high-statistics samples of Higgs bosons produced through WW-fusion, enabling tight constraints on the Higgs boson couplings. Studies of the rarer processes e+e- -> ttH and e+e- -> HHnunu allow measurements of the top Yukawa coupling and the Higgs boson self-coupling. This paper presents detailed studies of the precision achievable with Higgs measurements at CLIC and describes the interpretation of these measurements in a global fit.

Arnold D.B.Sankur M. D. Negrete-Pincetic M. Callaway D.S. (2017) Model-Free Optimal Coordination of Distributed Energy Resources for Provisioning Transmission-Level Services. IEEE Transactions on Power Systems. vol.PP, no.99, pp.1-1

Abstract:
Collective control of Distributed Energy Resources (DER) – such as PV inverters or battery storage – have the potential to provide regulation services to the bulk electric grid. While optimal power flow techniques may be used to coordinate DER for this purpose, these approaches typically rely on accurate network models and a large number of system measurements. In this work, we consider an approach that alleviates these modeling and measurement requirements. Here, we consider a 2-dimensional adaptive control scheme known as Extremum Seeking, or ES, to perform optimization without knowledge of a model of the distribution network. We apply this scheme to enable simultaneous feeder head active power and voltage magnitude reference tracking, as well as feeder voltage regulation. From the perspective of the transmission grid, this approach essentially transforms the distribution feeder into a controllable (P,V) bus. Simulation results confirm the ability of the approach to track substation real power and voltage reference signals while maintaining distribution system voltages within acceptable tolerances.

Arrieta C., Uribe S., Sing-Long C., Hurtado D., Andía M., Irarrázaval P., Tejos C. (2017) Simultaneous left and right ventricle segmentation using topology preserving level sets. Biomedical Signal Processing and Control, V.33, March 2017, Pp. 88–95 doi.org/10.1016/j.bspc.2016.11.002

Abstract:
Cardiovascular Magnetic Resonance (CMR) has been successfully used in clinical practice to evaluate the cardiac function. Heart functional indexes, such as end-systolic volume and end-diastolic volume, are usually computed from manual segmentations performed by an expert using short-axis cine MR images. This process is tedious and time consuming. Despite semi-automatic methods have been proposed, including pixel-based, atlas-based, active contours and level sets, most of them allow the segmentation of only one ventricle at a time, and methods for segmenting both ventricles simultaneously tend to fail in the presence of abnormal anatomies.
We propose a method based on level sets with preserved topology that allows simultaneous, fast and accurate segmentations of the left and right ventricles. We compared our segmentation results of the left and right ventricles with those obtained with clinically validated software (Viewforum, Philips, Best and Segment, Medviso, Lund) using two-tailored paired t-test, Pearson's correlation, Bland-Altman plots of standard functional indexes and voxel-by-voxel analysis with Dice. Two-tailored paired t-test showed no significant difference between our method and gold standards ($P < 0.05$), Pearson's correlation showed a high correlation of our measurement with gold standards (over 0.98), Dice showed an average agreement over or equal to 0.90 and Bland Altman analysis showed that our method has a good agreement with the gold standard segmentations. We were able to segment both ventricles simultaneously, without any training process and taking less than 15 s per cardiac phase. The process was semi-automatic with only minor manual corrections needed at the basal slices. Our results show high levels of accuracy considering functional indexes and also in a voxel-to-voxel comparison.

Bustos C. and Watts D. (2017) Novel methodology for microgrids in isolated communities: Electricity cost-coverage trade-off with 3-stage technology mix, dispatch & configuration optimizations. Applied Energy 195 204–221

Abstract:
Around the world, 1.1 billion people are severely affected by their lack of access to electricity. Other vulnerable communities receive low quality access, or face expensive prices that force them to restrict their consumption because of suboptimal technology choices made by their suppliers, which are sometimes forced by local regulation. Microgrids, properly sized and managed, may represent the best option to overcome these dilemmas, offering a tailor made supply. Today's standard methodologies to design isolated microgrids optimize the cost of supply as well as the cost of the energy not served with an exogenous per unit value for the lost load. They do not include community's restrictions, such as willingness-to-pay, consumption level, budget constraints or its particular (endogenous) value of lost load. We developed a novel methodology that offers a range of microgrid designs to an isolated community, where each of them is optimal for a particular consumption pattern and value of lost load, from which the community may choose the one that best suits their needs. For this purpose, a Pareto optimal cost-coverage trade-off was constructed for an isolated community in northern Chile. A three-stage optimization was done: capacity (Genetic Algorithm), operation (robust optimization and mixed integer linear programming) and configuration (DC or AC). Diesel, gas, PV, wind and storages were modeled and 176 designs were found in total. More expensive microgrids (and with a larger electricity coverage) have hybrid mixes (conventional and renewable) and have an

almost linear total cost from 298 to 249 USD/MW h for ENS from 0% to 28%. Lower quality microgrids are fully renewable, providing a very cheap but unreliable supply. The direct impact of lower-cost/limited supply microgrids offered here is the improvement of the quality of life of millions of vulnerable people, but it requires adjustments in the country's public policies of electrification programs.

Bustos C.Watts D. Ayala M. (2017) Financial risk reduction in photovoltaic projects through ocean-atmospheric oscillations modelingRenewable & Sustainable Energy Reviews Volume 74, July 2017, Pages 548-568

Abstract:
The impact of climate change on society has increased the interest to deploy renewable energies and to understand climate. Climate variability is partly predictable and is a fundamental factor in explaining financial risk in renewable energy projects. Current methodologies used for risk assessment do not appropriately account for climate predictability. We found limited literature on risk reduction on PV projects through the modeling of predictable components of solar radiation and ocean-atmospheric oscillations, allowing us to present original proposals to fill these voids. A new profit model for PV plants was developed, capturing this predictable climate information. The proposed methodology is potentially applicable to hydro, wind and other renewable resources, and allows leaving aside predictable climate components from the project's risk calculation. The model was tailored for the risk assessment of PV investments and is applied over 10 geographical areas across Chile, the largest PV market in Latin America, where climate is strongly affected by 3 ocean-atmospheric oscillations (El Niño Southern Oscillation, Southern Annular Mode, and Indian Ocean Dipole). Using the model in these regions allows reducing the monthly financial the risk to reduce by 60–81% compared to traditional methodology. For a 100 MW PV project located in those areas, this means reducing annualized risk from 4.93 to 7.88 MM $USD/year (traditional model) to 1.11–2.38 MM USD/year (proposed model). Modeling of ocean-atmospheric oscillations allows achieving the greatest risk reduction between the cities of Copiapó and Coquimbo (north-central regions), decreasing their influence towards the extreme latitudes. Their risk reduction will depend on the quality of the model, and may have strong implications for both investors and financial institutions. It could also impact competition in the energy sector due to possible asymmetries of information. To facilitate extending the use of the model elsewhere, the incorporation of subsidies is discussed.

Chen X., Usman M., Baumgartner C.F., Balfour D.R., Marsden P.K., Reader A.J., Prieto C., King A.P. (2017) High-Resolution Self-Gated Dynamic Abdominal MRI Using Manifold Alignment. IEEE Transactions on Medical Imaging, V.36, (4) Pp. 960-971, April 2017. doi: 10.1109/TMI.2016.2636449

Abstract:
We present a novel retrospective self-gating method based on manifold alignment (MA), which enables reconstruction of free breathing, high spatial, and temporal resolution abdominal magnetic resonance imaging sequences. Based on a radial golden-angle acquisition trajectory, our method enables a multidimensional self-gating signal to be extracted from the k-space data for more accurate motion representation. The k-space radial profiles are evenly divided into a number of overlapping groups based on their radial angles. MA is then used to simultaneously

learn and align the low dimensional manifolds of all groups, and embed them into a common manifold. In the manifold, k-space profiles that represent similar respiratory positions are close to each other. Image reconstruction is performed by combining radial profiles with evenly distributed angles that are close in the manifold. Our method was evaluated on both 2-D and 3-D synthetic and in vivo data sets. On the synthetic data sets, our method achieved high correlation with the ground truth in terms of image intensity and virtual navigator values. Using the in vivo data, compared with a state-of-the-art approach based on the center of k-space gating, our method was able to make use of much richer profile data for self-gating, resulting in statistically significantly better quantitative measurements in terms of organ sharpness and image gradient entropy.

Cruz G.Atkinson D.Henningsson M.Botnar R. Prieto C. (2017) Highly efficient nonrigid motion-corrected 3D whole-heart coronary vessel wall imaging. Magnetic Resonance in Medicine, V.77 (5) Pp. 1894–1908. 10.1002/mrm.26274

Abstract:

Purpose. To develop a respiratory motion correction framework to accelerate free-breathing three-dimensional (3D) whole-heart coronary lumen and coronary vessel wall MRI.

Methods. We developed a 3D flow-independent approach for vessel wall imaging based on the subtraction of data with and without T2-preparation prepulses acquired interleaved with image navigators. The proposed method corrects both datasets to the same respiratory position using beat-to-beat translation and bin-to-bin nonrigid corrections, producing coregistered, motion-corrected coronary lumen and coronary vessel wall images. The proposed method was studied in 10 healthy subjects and was compared with beat-to-beat translational correction (TC) and no motion correction for the left and right coronary arteries. Additionally, the coronary lumen images were compared with a 6-mm diaphragmatic navigator gated and tracked scan.

Results. No significant differences ($P > 0.01$) were found between the proposed method and the gated and tracked scan for coronary lumen, despite an average improvement in scan efficiency to 96% from 59%. Significant differences ($P < 0.01$) were found in right coronary artery vessel wall thickness, right coronary artery vessel wall sharpness, and vessel wall visual score between the proposed method and TC.

Conclusion. The feasibility of a highly efficient motion correction framework for simultaneous whole-heart coronary lumen and vessel wall has been demonstrated.

De la Llera J. Rivera F.Mitrani-Reiser J.Junemann R. Fortuño C.Ríos M. Hube M. Santa María H. Cienfuegos R. (2017) Data collection after the 2010 Maule earthquake in Chile. Bulletin of Earthquake Engineering February 2017, Volume 15, Issue 2, pp 555–588.

Abstract:

This article presents an overview of the different processes of data recollection and the analysis that took place during and after the emergency caused by the Mw 8.8 2010 Maule earthquake in central-south Chile. The article is not an exhaustive recollection of all of the processes and methodologies used; it rather points out some of the critical processes that took place with special emphasis in the earthquake characterization and building data. Although there are strong similarities in all of the different data recollection processes after the earthquake, the evidence shows that a rather disaggregate approach was used by the different stakeholders.

Moreover, no common standards were implemented or used, and the resulting granularity and accuracy of the data was not comparable even for similar structures, which sometimes led to inadequate decisions. More centralized efforts were observed in resolving the emergency situations and getting the country back to normal operation, but the reconstruction process took different independent routes depending on several external factors and attitudes of individuals and communities. Several conclusions are presented that are lessons derived from this experience in dealing with a large amount of earthquake data. The most important being the true and immediate necessity of making all critical earthquake information available to anyone who seeks to study such data for a better understanding of the earthquake and its consequences. By looking at the information provided by all these data, we aim to finally improve seismic codes and engineering practice, which are important social goods.

Ginami G., Neji R., Phinikaridou A., Whitaker J., Botnar R.M. and Prieto C.(2017) Simultaneous bright- and black-blood whole-heart MRI for noncontrast enhanced coronary lumen and thrombus visualization. Magnetic Resonance in Medicine.

Abstract:
Purpose: To develop a novel 3D whole-heart Bright-blood and black blOOd phase SensiTive inversion recovery (BOOST) sequence for simultaneous non-contrast enhanced coronary lumen, thrombus and intraplaque hemorrhage visualization. Methods: The proposed BOOST sequence alternates the acquisition of two differently weighted bright-blood datasets that are then combined in a phase sensitive inversion recovery (PSIR)-like reconstruction to obtain a third, fully coregistered, black-blood dataset. The bright-blood datasets are used for both visualization of the coronary lumen and motion estimation, whereas the complementary black-blood dataset allows thrombus and hemorrhage visualization. Furthermore, integration with 2D image-based navigation enables 100% scan efficiency and predictable scan times. The proposed sequence was validated in a standardized phantom and compared to conventional coronary MR angiography (CMRA) and PSIR sequences in healthy subjects. Feasibility for thrombus depiction was tested ex-vivo in a pig heart. Results: With BOOST, the coronary lumen is visualized with significantly higher ($P<0.05$) SNR, CNR and vessel sharpness when compared to conventional CMRA. Furthermore, BOOST showed effective blood signal suppression as well as feasibility for thrombus visualization ex-vivo. Conclusion: A new PSIR sequence for non-contrast enhanced simultaneous coronary lumen and thrombus/hemorrhage detection was developed. The sequence provided improved coronary lumen depiction and effective thrombus visualization.

González-Núñez H., Bechet C., Ayancán B., Neichel B., Guesalaga A. (2017) Effect of the influence function of deformable mirrors on laser beam shaping. Applied Optics, V.56 (6) Pp. 1637. doi.org/10.1364/AO.56.001637

Abstract:
The continuous membrane stiffness of a deformable mirror propagates the deformation of the actuators beyond their neighbors. When phase-retrieval algorithms are used to determine the desired shape of these mirrors, this cross-coupling—also known as influence function (IF)—is generally disregarded. We study this problem via simulations and bench tests for different target shapes to gain further insight into the phenomenon. Sound modeling of the IF effect is achieved as highlighted by the concurrence between the modeled and experimental results. In

addition, we observe that the actuators IF is a key parameter that determines the accuracy of the output light pattern. Finally, it is shown that in some cases it is possible to achieve better shaping by modifying the input irradiance of the phase-retrieval algorithm. The results obtained from this analysis open the door to further improvements in this type of beam-shaping systems.

Guesalaga A. Neichel B.Correia C.M.Butterley T.Osborn J.Masciadri E.Fusco T.Sauvage J.-F. (2017) On line estimation of the wavefront outer scale profile from adaptive optics telemetry. Monthly Notices of the Royal Astronomical Society V.465 (2) Pp.1984-1994. doi.org/10.1093/mnras/stw2548

Abstract:
We describe an online method to estimate the wavefront outer scale profile, L0(h), for very large and future extremely large telescopes. The stratified information on this parameter impacts the estimation of the main turbulence parameters [turbulence strength, Cn2(h); Fried's parameter, r0; isoplanatic angle, θ0; and coherence time, τ0) and determines the performance of wide-field adaptive optics (AO) systems. This technique estimates L0(h) using data from the AO loop available at the facility instruments by constructing the cross-correlation functions of the slopes between two or more wavefront sensors, which are later fitted to a linear combination of the simulated theoretical layers having different altitudes and outer scale values. We analyse some limitations found in the estimation process: (i) its insensitivity to large values of L0(h) as the telescope becomes blind to outer scales larger than its diameter; (ii) the maximum number of observable layers given the limited number of independent inputs that the cross-correlation functions provide and (iii) the minimum length of data required for a satisfactory convergence of the turbulence parameters without breaking the assumption of statistical stationarity of the turbulence. The method is applied to the Gemini South multiconjugate AO system that comprises five wavefront sensors and two deformable mirrors. Statistics of L0(h) at Cerro Pachón from data acquired during 3 yr of campaigns show interesting resemblance to other independent results in the literature. A final analysis suggests that the impact of error sources will be substantially reduced in instruments of the next generation of giant telescopes.

Gutiérrez-Jarpa G., Laporte G., Marianov V. and Moccia L. (2017) Multi-objective rapid transit network design with modal competition: The case of Concepción, Chile. Computers & Operations Research 78 27-43

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

Hallakoun N., Xu S., Maoz D., Marsh T.R., Ivanov V.D., Dhillon V.S., Bours M.C.P., Parsons S.G., Kerry P., Sharma S., Su K., Rengaswamy S., Pravec P., Kušnirák P., Kučáková H., Armstrong J.D., Arnold C., Gerard N. and Vanzi L.(2017) Once in a blue moon: detection of `bluing' during debris transits in the white dwarf WD 1145+017 Monthly Notices of the Royal Astronomical Society 469 3 3213 – 3224

Abstract:
The first transiting planetesimal orbiting a white dwarf was recently detected in K2 data of WD 1145+017 and has been followed up intensively. The multiple, long and variable transits suggest the transiting objects are dust clouds, probably produced by a disintegrating asteroid. In addition, the system contains circumstellar gas, evident by broad absorption lines, mostly in the u' band, and a dust disc, indicated by an infrared excess. Here we present the first detection of a change in colour of WD 1145+017 during transits, using simultaneous multiband fast-photometry ULTRACAM measurements over the u'g'r'i' bands. The observations reveal what appears to be 'bluing' during transits; transits are deeper in the redder bands, with a u' – r' colour difference of up to ˜-0.05 mag. We explore various possible explanations for the bluing, including limb darkening or peculiar dust properties. 'Spectral' photometry obtained by integrating over bandpasses in the spectroscopic data in and out of transit, compared to the photometric data, shows that the observed colour difference is most likely the result of reduced circumstellar absorption in the spectrum during transits. This indicates that the transiting objects and the gas share the same line of sight and that the gas covers the white dwarf only partially, as would be expected if the gas, the transiting debris and the dust emitting the infrared excess are part of the same general disc structure (although possibly at different radii). In addition, we present the results of a week-long monitoring campaign of the system using a global network of telescopes.

Henríquez F., Jerez-Hanckes C. and Altermatt F.(2017) Boundary integral formulation and semi-implicit scheme coupling for modeling cells under electrical stimulation. Numerische Mathematik 136 1 101-145

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

Henríquez R., Wenzel G., Olivares D., Negrete-Pincetic M. (2017) Participation of Demand Response Aggregators in Electricity Markets: Optimal Portfolio Management. IEEE Transactions on Smart Grid, IEEE Transactions on Smart Grid , vol.PP, no.99, pp.1-1. doi: 10.1109/TSG.2017.2673783

Abstract:

Demand response (DR) is a versatile way of providing flexibility in power systems. In order to manage the flexibility of a large number of scattered DR resources, in the context of electricity markets, they must be aggregated by a new participant called the DR aggregator. This work presents an optimization model to determine the optimal operation of a DR aggregator that manages a portfolio of DR programs in wholesale electricity markets. The aggregator is considered to be a strategic participant in the real-time market. The portfolio is composed of various contracts of load curtailment and flexible loads that can be executed for hourly load change. Uncertainty of market prices and balancing requirements are represented through a set of scenarios based on historical data. The proposed model is a stochastic bi-level mathematical program that is reformulated as a mixed-integer linear program (MILP). Several case studies with numerical results are presented.

Jara M., Alessandri C., Abusleme A. (2017) Time-domain 1/f noise analysis of a charge-redistribution Track-and-Hold circuit. IEEE Transactions on Circuits and Systems II: Express Briefs , vol.PP, no.99, pp.1-1. doi: 10.1109/TCSII.2017.2684123

Abstract:
Track-and-Hold (T&H) circuits are used in a variety of applications. Noise is a key parameter in a T&H and can be traded for settling time or power consumption. The classical T&H noise design methodology considers only white noise sources, neglecting low-frequency noise sources. Although low-frequency noise contributions have been analyzed in the literature, an insightful, design-oriented analysis for flicker noise that can also be extended for arbitrary noise sources has not been proposed yet. In this brief we present a time-domain noise analysis for a charge-redistribution T&H circuit. The analysis considers the noise contribution from white and 1/f sources. A design-oriented expression to compute the excess noise power due to flicker noise, as a function of the sampling rate, the intended T&H resolution, and the noise parameters, is obtained. This expression shows the dependence of the relative contribution of flicker noise over white noise, on the T&H design parameters. A simplified expression allows one to assess the relative contribution of flicker noise during an early stage of the design flow.

Jerez-Hanckes C., Pérez-Arancibia C. and Turc C.(2017) Multitrace/singletrace formulations and Domain Decomposition Methods for the solution of Helmholtz transmission problems for bounded composite scatterers. Journal of Computational Physics 350 343-360

Abstract:
We present Nyström discretizations of multitrace/singletrace formulations and non-overlapping Domain Decomposition Methods (DDM) for the solution of Helmholtz transmission problems for bounded composite scatterers with piecewise constant material properties. We investigate the performance of DDM with both classical Robin and optimized transmission boundary conditions. The optimized transmission boundary conditions incorporate square root Fourier multiplier approximations of Dirichlet to Neumann operators. While the multitrace/singletrace formulations as well as the DDM that use classical Robin transmission conditions are not particularly well suited for Krylov subspace iterative solutions of high-contrast high-frequency Helmholtz transmission problems, we provide ample numerical evidence that DDM with optimized transmission conditions constitute efficient computational alternatives for these type of applications. In the case of large numbers of subdomains with different material properties,

we show that the associated DDM linear system can be efficiently solved via hierarchical Schur complements elimination.

Jerez-Hanckes C. and Schwab C.(2017). Electromagnetic Wave Scattering by Random Surfaces: Uncertainty Quantification via Sparse Tensor Boundary Elements. IMA Journal of Numerical Analysis, 37 (3) pp.1175-1210.

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

Jerez-Hanckes C., Schwab C. and Zech J.(2017). Electromagnetic Wave Scattering by Random Surfaces: Shape Holomorphy. Mathematical Models & Methods in Applied Sciences, Volume 27, Issue 12, November 2017. Pp.2229

Abstract:
For time-harmonic electromagnetic waves scattered by either perfectly conducting or dielectric bounded obstacles, we show that the fields depend holomorphically on the shape of the scatterer. In the presence of random geometrical perturbations, our results imply strong measurability of the fields, in weighted spaces in the exterior of the scatterer. These findings are key to prove dimension-independent convergence rates of sparse approximation techniques of polynomial chaos type for forward and inverse computational uncertainty quantification. Also, our shape-holomorphy results imply parsimonious approximate representations of the corresponding parametric solution families, which are produced, for example, by greedy strategies such as model order reduction or reduced basis approximations. Finally, the presently proved shape holomorphy results imply convergence of shape Taylor expansions of far-field patterns for fixed amplitude domain perturbations in a vicinity of the nominal domain, thereby extending the widely used asymptotic linearizations employed in first-order, second moment domain uncertainty quantification.

Lorca A. and Sun X.A. (2017) The Adaptive Robust Multi-Period Alternating Current Optimal Power Flow Problem IEEE Transactions on Power Systems.

Abstract:
This paper jointly addresses two major challenges in power system operations: i) dealing with non-convexity in the power flow equations, and ii) systematically capturing uncertainty in renewable power availability and in active and reactive power consumption at load buses. To overcome these challenges, this paper proposes a two-stage adaptive robust optimization model for the multi-period AC optimal power flow problem (AC-OPF) with detailed modeling considerations such as reactive capability curves of conventional and renewable generators and transmission constraints. This paper then applies strong SOCP-based convex relaxations of AC-OPF combined with the use of an alternating direction method to identify worst-case uncertainty realizations, and also presents a speed-up technique based on screening transmission line constraints. Extensive computational experiments show that the solution method is efficient and that the robust AC OPF model has significant advantages both from the economic and reliability standpoints as compared to a deterministic AC-OPF model.

Lorca A. Çelik M.Ergun O.Keskinocak P. (2017) An Optimization-Based Decision-Support Tool for Post-Disaster Debris Operations. Production and Operations Management, 10.1111/poms.12643

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

Milovic C., Conejero J., Tejos C. (2017) Multiscale gradient domain compression for astronomical high dynamic range imaging. The Imaging Science Journal V. 64 (7) Pp. 353-363. dx.doi.org/10.1179/1743131X15Y.0000000028

Abstract:
Visualisation of high dynamic range images requires compression of the data to be properly displayed on media with more limited dynamic ranges. Astronomical images pose a difficult challenge for dynamic range compression algorithms, due to the nature of the imaged objects and to the lack of a reflectance illumination model based on spatial frequencies. As a result, most of the algorithms commonly used for daylight high dynamic range compression fail in achieving an optimal visualisation of astronomical targets. We propose an extended multiscale algorithm based on compression of the dynamic range in the gradient domain. Our algorithm effectively compresses the dynamic range, enhances local contrast and avoids noise amplification. This is achieved with a multiscale representation of the image and the use of luminance information. Our results show a significantly improved visualisation of astronomical

images compared to the standard gradient domain compression, as well as more robustness to noise and better artefact suppression.

Molina J.D., Contreras J., Rudnick H. (2017) A Risk-Constrained Project Portfolio in Centralized Transmission Expansion Planning. IEEE Systems Journal , vol.PP, no.99, pp.1-9. doi: 10.1109/JSYST.2014.2345736

Abstract:
The implementation of a centralized transmission expansion plan is a complex task when several investors compete and bid to build a new transmission asset, as is the case now in Chile. The assessment of a transmission project depends on the number of competitors, where the project is subject to risks, such as delays, penalties, and cost overruns. The risk faced by an investor is measured using the Conditional Value at Risk (CVaR), which can be interpreted as the risk of not reaching an expected return on investment, depending on the tolerance to risk and the real income obtained with the investor's portfolio. This risk comes from the difference between the regulated income (investor's bid) and the real cost during the implementation and operation of the transmission project. The difference is the “surplus” profit that the investor obtains by participating in the tender, considering their risk tolerance. The goal is to determine the optimal value of a risky investor's portfolio made up of several transmission projects. The optimal portfolio may allow the central planner to improve the efficiency of the project allocation process. To test the methodology, two case studies are analyzed: the IEEE 24-bus Reliability Test System and a predefined expansion plan of Chile's Central Interconnected System (SIC).

Montalba C., Urbina J., Sotelo J., Andia M., Tejos C., Irarrázaval P., Hurtado D.E. and Valverde I.(2017). Variability of 4D flow parameters when subjected to changes in MRI acquisition parameters using a realistic thoracic aortic phantom. Magnetic Resonance in Medicine

Abstract:
Purpose: To assess the variability of peak flow, mean velocity, stroke volume, and wall shear stress measurements derived from 3D cine phase contrast (4D flow) sequences under different conditions of spatial and temporal resolutions.
Methods: We performed controlled experiments using a thoracic aortic phantom. The phantom was connected to a pulsatile flow pump, which simulated nine physiological conditions. For each condition, 4D flow data were acquired with different spatial and temporal resolutions. The 2D cine phase contrast and 4D flow data with the highest available spatio-temporal resolution were considered as a reference for comparison purposes.
Results: When comparing 4D flow acquisitions (spatial and temporal resolution of $2.0 \times 2.0 \times 2.0$ mm3 and 40 ms, respectively) with 2D phase-contrast flow acquisitions, the underestimation of peak flow, mean velocity, and stroke volume were 10.5, 10 and 5%, respectively. However, the calculated wall shear stress showed an underestimation larger than 70% for the former acquisition, with respect to 4D flow, with spatial and temporal resolution of $1.0 \times 1.0 \times 1.0$ mm3 and 20 ms, respectively.
Conclusions: Peak flow, mean velocity, and stroke volume from 4D flow data are more sensitive to changes of temporal than spatial resolution, as opposed to wall shear stress, which is more sensitive to changes in spatial resolution.

Muñoz C., Neji R., Cruz G., Mallia A., Jeljeli S., Reader A.J., Botnar R.M. and Prieto C. (2017) Motion Corrected Simultaneous Cardiac PET and Coronary MR Angiography with High Acquisition Efficiency. Magnetic Resonance in Medicine.

Abstract:
Purpose: Develop a framework for efficient free-breathing simultaneous whole-heart coronary magnetic resonance angiography (CMRA) and cardiac positron emission tomography (PET) on a 3T PET-MR system. Methods: An acquisition that enables non-rigid motion correction of both CMRA and PET has been developed. The proposed method estimates translational motion from low-resolution 2D MR image-navigators acquired at each heartbeat, and 3D non-rigid respiratory motion between different respiratory bins from the CMRA data itself. Estimated motion is used for correcting the CMRA as well as the emission and attenuation PET datasets to the same respiratory position. The CMRA approach was studied in ten healthy subjects and compared for both left and right coronary arteries (LCA, RCA) against a reference scan with diaphragmatic navigator gating and tracking. The PET-CMRA approach was tested in five oncology patients with 18F-FDG myocardial uptake. PET images were compared against uncorrected and gated PET reconstructions. Results: For the healthy subjects, no statistically significant differences in vessel length and sharpness ($P>0.01$) were observed between the proposed approach and the reference acquisition with navigator gating and tracking although data acquisition was significantly shorter. The proposed approach improved CMRA vessel sharpness by 37.9%, 49.1% (LCA, RCA) and vessel length by 48.0%, 36.7% (LCA, RCA) in comparison with no motion correction for all the subjects. Motion-corrected PET images showed improved sharpness of the myocardium compared to uncorrected reconstructions and reduced noise compared to gated reconstructions. Conclusion: Feasibility of a new respiratory motion compensated simultaneous cardiac PET-CMRA acquisition has been demonstrated.

Naranjo Lourido W., Muñoz L., Pereda J., Cortés C.A. (2017) Design of Electric Buses for Rapid Transit using Hybrid Energy Storage and Local Traffic Parameters. IEEE Transactions on Vehicular Technology , vol.PP, no.99, pp.1-1. doi: 10.1109/TVT.2016.2616401

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

Negrete-Pincetic M., Nayyar A., Poolla K., Salah F., Varaiya P. (2017) Rate-constrained Energy Services in Electricity. IEEE Transactions on Smart Grid, IEEE Transactions on Smart Grid , vol.PP, no.99, pp.1-1.

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

Negrete-Pincetic M., Wang G., Arancibia M., Kowli A., Shafieepoofard E. and Meyn S. (2017) The value of volatile resources in electricity markets. Sustainable Energy Grids & Networks 11 46-57.

Abstract:
The rapid adoption of renewable generation has brought volatility to the grid as well as electricity markets. There is a need for models and analytical techniques to obtain insight on the cost of volatility, and the benefits of responsive technologies that can provide ancillary services to mitigate this cost. The model introduced in this paper is based on typical markets in operation today, in which day-ahead and real-time power markets are used to schedule resources to maintain supply–demand balance. The real-time market model is the diffusion model introduced in prior work. Analysis is conducted in an idealized competitive equilibrium setting. The introduction of a coupled day-ahead market is novel, and can be used to quantify the costs and benefits of generation from renewable resources. Closed-form expressions are obtained for the supplier and consumer surpluses based on computations for an associated two-dimensional diffusion process. These formulae quantify how the value of wind generation falls with volatility, and also how this cost can be reduced with the introduction of responsive ancillary services. Perhaps surprisingly, it is found in numerical experiments that the introduction of generation from wind may result in significant gains for the supplier of traditional generation respect to the case without volatile resources, even when the consumer owns and controls the wind farm.

Núñez, F., Wang Y., Grasing D., Desai S., Cakiades G., Doyle F.J. (2017) Pulse-coupled time synchronization for distributed acoustic event detection using wireless sensor networks. Control Engineering Practice, V. 60, March 2017, Pp. 106–117. doi.org/10.1016/j.conengprac.2017.01.006

Abstract:
Time synchronization has proven to be critical in sensor fusion applications where the time of arrival is utilized as a decision variable. Herein, the application of pulse-coupled synchronization to an acoustic event detection system based on a wireless sensor network is presented. The aim of the system is to locate the source of acoustic events utilizing time of arrival measurements for different formations of the sensor network. A distributed localization algorithm is introduced that solves the problem locally using only a subset of the time of arrival measurements and then fuses the local guesses using averaging consensus techniques. It is shown that the pulse-coupled strategy provides the system with the proper level of synchronization needed to enable accurate localization, even when there exists drift between the internal clocks and the formation is not perfectly maintained. Moreover, the distributed nature of pulse-coupled synchronization allows coordinated synchronization and distributed localization over an infrastructure-free ad-hoc network.

Papandroulidakis G.Vourkas I.Abusleme A. Sirakoulis G.Rubio A. (2017) Crossbar-Based Memristive Logic-In-Memory Architecture. IEEE Transactions on Nanotechnology. vol. 16, no. 3, pp. 491-501, May 2017.
Abstract:
The use of memristors and resistive random access memory (ReRAM) technology to perform logic computations, has drawn considerable attention from researchers in recent years. However, the topological aspects of the underlying ReRAM architecture and its organization have received less attention, as the focus has mainly been on device-specific properties for functionally complete logic gates through conditional switching in ReRAM circuits. A careful investigation and optimization of the target geometry is thus highly desirable for the implementation of logic-in-memory architectures. In this paper, we propose a crossbar-based in-memory parallel processing system in which, through the heterogeneity of the resistive cross-point devices, we achieve local information processing in a state-of-the-art ReRAM crossbar architecture with vertical group-accessed transistors as cross-point selector devices. We primarily focus on the array organization, information storage, and processing flow, while proposing a novel geometry for the cross-point selection lines to mitigate current sneak-paths during an arbitrary number of possible parallel logic computations. We prove the proper functioning and potential capabilities of the proposed architecture through SPICE-level circuit simulations of half-adder and sum-of-products logic functions. We compare certain features of the proposed logic-in-memory approach with another work of the literature, and present an analysis of circuit resources, integration density, and logic computation parallelism.

Paredes-Belmar G., Bronfman A., Marianov V. and Latorre-Núñez G.(2017) Hazardous materials collection with multiple-product loading. Journal of Cleaner Production 141 909-919
Abstract:
We present a new hazardous material (HAZMAT) collection problem in which various industrial HAZMAT are transported using a homogeneous capacitated truck fleet. Different materials have different risk levels in terms of the size of exposed population. A truck can simultaneously carry different materials. The size of the population exposed to a loaded truck increases if a higher risk material is added to the load. We minimize the total exposed

population and the total transportation cost. We present a case study in the City of Santiago in Chile to show practical application of our proposed approach.

Paredes-Belmar G., Lüer-Villagra A., Marianov V., Cortés C.E., Bronfman A. (2017) The milk collection problem with blending and collection points. Computers and Electronics in Agriculture, V.134, March 2017, Pp. 109–123, doi.org/10.1016/j.compag.2017.01.015

Abstract:
A novel problem for the collection of raw milk from a network of farms supplying a dairy is specified and solved. The proposed approach incorporates milk blending and the delivery of production to collection points by small, distant farms. The milk is collected by, and blended in, a homogeneous fleet of trucks and classified according to the lowest quality product included in the blend. Optimization criteria are used to determine where the collection points should be located and which producers are allocated to them for delivery, with all other production picked up directly at the farms. The approach is built around an integer programming model and two implementation strategies, one using a branch-and-cut algorithm for small instances and the other a heuristic procedure combining both exact and approximated methods to handle large instances within a reasonable computation time. A real case study involving 500 farms and 112 possible collection points is solved and the results compared. The impact on the solutions of dividing the real instance into zones is also explored.

Sotelo J.Urbina J.Valverde I.Mura J.Tejos C. Irarrázaval P.Andia M.E.Hurtado D.E.Uribe S. (2017) Three-dimensional quantification of vorticity and helicity from 3D cine PC-MRI using finite-element interpolations. Magnetic Resonance in Medicine. 2017 Mar 31.

Abstract:
PURPOSE:
We propose a 3D finite-element method for the quantification of vorticity and helicity density from 3D cine phase-contrast (PC) MRI.
METHODS:
By using a 3D finite-element method, we seamlessly estimate velocity gradients in 3D. The robustness and convergence were analyzed using a combined Poiseuille and Lamb-Ossen equation. A computational fluid dynamics simulation was used to compared our method with others available in the literature. Additionally, we computed 3D maps for different 3D cine PC-MRI data sets: phantom without and with coarctation (18 healthy volunteers and 3 patients).
RESULTS:
We found a good agreement between our method and both the analytical solution of the combined Poiseuille and Lamb-Ossen. The computational fluid dynamics results showed that our method outperforms current approaches to estimate vorticity and helicity values. In the in silico model, we observed that for a tetrahedral element of 2 mm of characteristic length, we underestimated the vorticity in less than 5% with respect to the analytical solution. In patients, we found higher values of helicity density in comparison to healthy volunteers, associated with vortices in the lumen of the vessels.
CONCLUSIONS:

We proposed a novel method that provides entire 3D vorticity and helicity density maps, avoiding the used of reformatted 2D planes from 3D cine PC-MRI. Magn Reson Med, 2017. © 2017 International Society for Magnetic Resonance in Medicine.

Tala M. Vanzi L. Ávila G.Guirao C.Pecchioli E.Zapata A.Pieralli F. (2017) Two simple image slicers for high resolution spectroscopy. Experimental Astronomy V.43, (2), pp 167–176. DOI: 10.1007/s10686-017-9526-5

Abstract:
We present the design, manufacturing, test and performance of two image slicers for high resolution spectroscopy. Based on the classical Bowen-Walraven concept, our slicers allow to make two slices of the image of the input fibre. We introduce the idea of a second fibre that can be cropped in half to reach the same width of the science target fibre and that can be used for simultaneous wavelength reference. The slicers presented are mirror and prism based, respectively. Both devices work within expectation, showing differences mainly in their efficiency. The prism based slicer is the solution that was adopted for the FIDEOS spectrograph, an instrument built by the AIUC for the ESO 1m telescope of La Silla. Test spectra obtained with this instrument are included as examples of a real application of the device.

Usman M.Ruijsink B.Nazir M.S.Cruz G.Prieto C. (2017) Free breathing whole-heart 3D CINE MRI with self-gated Cartesian trajectory Magnetic. Resonance Imaging V.38, May 2017, Pp.129–137doi.org/10.1016/j.mri.2016.12.021

Abstract:
Purpose. To present a method that uses a novel free-running self-gated acquisition to achieve isotropic resolution in whole heart 3D Cartesian cardiac CINE MRI.
Material and methods. 3D cardiac CINE MRI using navigator gating results in long acquisition times. Recently, several frameworks based on self-gated non-Cartesian trajectories have been proposed to accelerate this acquisition. However, non-Cartesian reconstructions are computationally expensive due to gridding, particularly in 3D. In this work, we propose a novel highly efficient self-gated Cartesian approach for 3D cardiac CINE MRI. Acquisition is performed using CArtesian trajectory with Spiral PRofile ordering and Tiny golden angle step for eddy current reduction (so called here CASPR-Tiger). Data is acquired continuously under free breathing (retrospective ECG gating, no preparation pulses interruption) for 4–5 min and 4D whole-heart volumes (3D + cardiac phases) with isotropic spatial resolution are reconstructed from all available data using a soft gating technique combined with temporal total variation (TV) constrained iterative SENSE reconstruction.
Results. For data acquired on eight healthy subjects and three patients, the reconstructed images using the proposed method had good contrast and spatio-temporal variations, correctly recovering diastolic and systolic cardiac phases. Non-significant differences ($P > 0.05$) were observed in cardiac functional measurements obtained with proposed 3D approach and gold standard 2D multi-slice breath-hold acquisition.
Conclusion. The proposed approach enables isotropic 3D whole heart Cartesian cardiac CINE MRI in 4 to 5 min free breathing acquisition.

Videla A., Matamala L.F., Uribe S., Andía M.E. (2017) Ferrous Ion oxidation monitoring by using magnetic resonance imaging for bio-oxidation laboratory testing. Minerals Engineering, V. 106, (15), Pages 108–115 doi.org/10.1016/j.mineng.2016.08.020

Abstract:
A non-invasive, non-destructive monitoring approach using three-dimensional (3D) Magnetic Resonance Imaging (MRI) is proposed to study the iron oxidation process driven by Ferrooxidans' bacterial activity. This activity is related to the oxidation of Fe2+ into Fe3+. Fe3+ ion has paramagnetic properties that could be used to visualize its presence using MRI. A novel MRI methodology has been implemented to visualize Fe3+ in solution with the aim to be used as a marker of iron oxidizer bacteria activity. A proof of concept test has been performed with bacteria in solution and in two solids media: an inert vegetal material (luffa) and solid particles, both dipped in acid solutions. The samples were scanned using a clinical 1.5 T MRI scan at several time points to test the capabilities of detecting different Fe3+ concentrations in the solution in time, while Ferrous Ion oxidation is driven by Ferrroxidans. The measurements were contrasted with titration methods to account for Ferrous Ion consumption during the process. The result reveals that a characteristic parameter obtained with MRI imaging, known as R1 relaxivity time measured in Hertz, correlates with Fe2+ oxidation (increment in Fe3+ concentration). 3D images of the distribution of Fe3+ production in the samples were acquired. Results are promising and open opportunities to continue complementary laboratory research at the network porous level to capture the spatial 3D distribution of Ferric Ions as distributed inside the porous network during a bio-reaction test.

Villalón-Sepúlveda G.Torres M. Flores-Calero M. (2017) Traffic sign detection system for locating road intersections and braking advance. Revista Iberoamericana de Automatica e Informatica Industrial Jun; 17(6): 1207.

Abstract:
This paper presents a traffic sign detection method for signs close to road intersections and roundabouts, such as stop and yield (give way) signs. The proposed method relies on statistical templates built using color information for both segmentation and classification. The segmentation method uses the RGB-normalized (ErEgEb) color space for ROIs (Regions of Interest) generation based on a chromaticity filter, where templates at 10 scales are applied to the entire image. Templates consider the mean and standard deviation of normalized color of the traffic signs to build thresholding intervals where the expected color should lie for a given sign. The classification stage employs the information of the statistical templates over YCbCr and ErEgEb color spaces, for which the background has been previously removed by using a probability function that models the probability that the pixel corresponds to a sign given its chromaticity values. This work includes an analysis of the detection rate as a function of the distance between the vehicle and the sign. Such information is useful to validate the robustness of the approach and is often not included in the existing literature. The detection rates, as a function of distance, are compared to those of the well-known Viola–Jones method. The results show that for distances less than 48 m, the proposed method achieves a detection rate of 87.5% and 95.4% for yield and stop signs, respectively. For distances less than 30 m, the detection rate is 100% for both signs. The Viola–Jones approach has detection rates below 20% for distances between 30 and 48 m, and barely improves in the 20–30 m range with detection rates of up to 60%. Thus, the proposed method provides a robust alternative for intersection detection that relies on statistical color-based templates instead of shape information. The experiments employed videos of traffic signs taken in several streets of Santiago, Chile, using a research

platform implemented at the Robotics and Automation Laboratory of PUC to develop driver assistance systems.

Villalón-Sepúlveda G.Torres M. Flores-Calero M. (2017) Traffic Sign Detection System for Locating Road Intersections and Roundabouts: The Chilean Case. Sensors May 25;17(6).

Abstract:
This paper presents a traffic sign detection method for signs close to road intersections and roundabouts, such as stop and yield (give way) signs. The proposed method relies on statistical templates built using color information for both segmentation and classification. The segmentation method uses the RGB-normalized (ErEgEb) color space for ROIs (Regions of Interest) generation based on a chromaticity filter, where templates at 10 scales are applied to the entire image. Templates consider the mean and standard deviation of normalized color of the traffic signs to build thresholding intervals where the expected color should lie for a given sign. The classification stage employs the information of the statistical templates over YCbCr and ErEgEb color spaces, for which the background has been previously removed by using a probability function that models the probability that the pixel corresponds to a sign given its chromaticity values. This work includes an analysis of the detection rate as a function of the distance between the vehicle and the sign. Such information is useful to validate the robustness of the approach and is often not included in the existing literature. The detection rates, as a function of distance, are compared to those of the well-known Viola-Jones method. The results show that for distances less than 48 m, the proposed method achieves a detection rate of 87.5 % and 95.4 % for yield and stop signs, respectively. For distances less than 30 m, the detection rate is 100 % for both signs. The Viola-Jones approach has detection rates below 20 % for distances between 30 and 48 m, and barely improves in the 20-30 m range with detection rates of up to 60 % . Thus, the proposed method provides a robust alternative for intersection detection that relies on statistical color-based templates instead of shape information. The experiments employed videos of traffic signs taken in several streets of Santiago, Chile, using a research platform implemented at the Robotics and Automation Laboratory of PUC to develop driver assistance systems.

Wang Y., Mosalakanti K., Núñez F., Deligeorges S. and Doyle III F.J. (2017) A kernel module for pulse-coupled time synchronization of sensor networks. Computer Networks 127 161-172

Abstract:
The biologically-inspired synchronization paradigm of pulse-coupled oscillators has received increased attention in the communications and sensor network communities as an appealing alternative to traditional packet-based synchronization strategies. Its inherent scalability, simplicity, and decentralized nature make pulse-coupled synchronization an attractive choice for time synchronization in wireless ad-hoc networks. However, in most current implementations, the pulse-coupled synchronization algorithm is coded in the application layer, which makes its performance susceptible to CPU processing load variations. Implementation of the pulse-coupled synchronization strategy in the physical layer is also reported, which however, is subject to difficulties in migration between different platforms. In this paper, we present the design, implementation, and evaluation of the pulse-coupled synchronization

strategy as a Linux kernel module. Our goal is to leverage the high portability and prioritized CPU access of kernel modules to 1) reduce the influence of disturbances from application layer programs on the synchronization performance; and 2) simultaneously make the synchronization strategy easily installable in Linux-based sensor networks. Both lab experiments and field tests were conducted to confirm the effectiveness of the results.

Watts D. Durán P.Flores Y. (2017) How Does El Nino Southern Oscillation Impact the Wind Resource in Chile? A Techno-Economical Assessment of the Influence of El Nino and La Nina on the Wind Power. Renewable Energy Volume 103, April 2017, Pages 128-142.

Abstract:

This paper assesses the impact of the El Niño Southern Oscillation (ENSO) on the wind speed, energy production, as well as its impact on the value of potential wind projects at different sites across Chile. The study applies cyclostationary empirical orthogonal function (CSEOF) analysis to isolate the ENSO influence on the wind speed, and therefore on the energy output of nearly all current and potential wind farms in Chile. Finally, a review of techno-economical parameters is made to assess the economic impact of an ENSO event occurring at different years in the lifetime of a wind energy project. The main contribution of this work is to establish the locations in Chile where this climatic oscillation is important for the system planning, the energy forecasting and the risk assessment.

Wensel G. Negrete-Pincetic M. Olivares D. MacDonald J. Callaway D.S. (2017) Real-Time Charging Strategies for an Electric Vehicle Aggregator to Provide Ancillary Services IEEE Transactions on Smart Grid. vol.PP, no.99, pp.1-1

Abstract:

Real-time charging strategies, in the context of vehicle to grid (V2G) technology, are needed to enable the use of electric vehicle (EV) fleets batteries to provide ancillary services (AS). In this paper we develop tools to manage charging and discharging in a fleet to track an Automatic Generation Control (AGC) signal when aggregated. We propose a real-time controller that considers bidirectional charging efficiency and extend it to study the effect of looking ahead when implementing Model Predictive Control (MPC). Simulations show that the controller improves tracking error as compared with benchmark scheduling algorithms, as well as regulation capacity and battery cycling.

Yandún Narváez F.J.Salvo del Pedregal J.Prieto P.A.Torres M. Auat Cheein F.A. (2017) LiDAR and thermal images fusion for ground-based 3D characterisation of fruit trees. Biosystems Engineering V. 151, November 2016, Pp. 479–494. doi.org/10.1016/j.biosystemseng.2016.10.012

Abstract:

The thermal behaviour of an orchard is intrinsically related to the plant physiological status and it is commonly observed using thermal imagery, in most cases, provided by a drone or by a satellite. Such remote sensing methods are currently popular since they allow to analyse large amounts of land data with few sensor readings. However, they are restricted by the spatial

resolution of the images, which always correspond to top views of the canopies. The latter does not allow for a side recording or analysis of the orchard. In this work, we design and evaluate a portable ground-based system for a manual thermal and geometrical characterisation of an orchard, merging thermal images with LiDAR-based range readings in order to obtain a 3D thermal reconstruction of the crop to overcome the previously mentioned issues. The proposed system can work in Global Navigation Satellite System (GNSS) denied environments and delivers multiple views of the orchard, offering the user a three-dimensional view of the thermal behaviour of the grove. Further, the implemented algorithm classifies points from the LiDAR measurements which correspond to the canopy using a supervised classifier. Later, a matching procedure is performed between such points and the thermal information provided by the thermal camera. In order to reconstruct the entire orchard or only a section of the grove, several frames are registered using the Iterative Closest Point algorithm. The system was tested in two conditions: in laboratory and in field within a plantation of Hass avocado, which is one of the main fruit trees growing in Chile, and its performance is compared with an LI-6400 Infra-red Gas Analyser (IRGA) portable photosynthesis system (LI-COR, Lincoln, NE).

IV. OTRAS PUBLICACIONES

Torres Torriti, M. Design of Mobile Robots, Chapter accepted in Rapid Roboting. Springer, 2017

V. PROYECTOS DE INVESTIGACION

- **Energía**

Development of a Model to Schedule the Cleaning of Large-scale PV Plants. ENEL Green Power. Department of Electrical Engineering, Ponticia Universidad Católica de Chile.
Co- Investigator: Alvaro Lorca

Corredor Solar de la Cuenca del Salado. CORFO Bienes Públicos, Department of Electrical Engineering, Ponticia Universidad Católica de Chile.
Co- Investigator: Alvaro Lorca
Co- Investigator: Daniel Olivares
Co- Investigator: Matías Negrete

Generation and Transmission Planning Models for Policy Analysis. Frauhofer CSET Seed Fund, Department of Electrical Engineering, Ponticia Universidad Católica de Chile.
Co- Investigator: Alvaro Lorca
Co-Investigator: Daniel Olivares
Co-Investigator: Matías Negrete

Agent-Based Modeling and Simulation for Energy Markets.
Investigador Responsable: Alvaro Lorca

Diseño e implementación de infraestructura tecnológica para la gestión de consumos flexibles en sistemas eléctricos.
Director: Matías Negrete
Investigador Asociado: Alvaro Lorca
Investigador Asociado: Christian Oberli
Director Alterno: Daniel Olivares

Charging Stations for Electric Vehicles, Notre Dame-UC ND-PUC 201507.
Investigator Responsible: Matías Negrete
Investigator Associate: Daniel Olivares

Power Systems Flexibility: From Characterization to Markets, Texas at Austin-UC TAUS-UC 201604.
Investigator Responsible: Daniel Olivares
Investigator Associate: Matías Negrete

Diseño, Integración, Ensayo y Caracterización de un Concepto Experimental de Sistema Híbrido de Conversión de Energía Solar en Energía Eléctrica y Térmica, FONDEF ID16I10331.
Investigador: Daniel Olivares

Active Demand Response Mechanisms for Exploiting Flexibility in Electricity Supply Models and Valuation, Fondecyt N°11140621.
Investigator Responsible: Daniel Olivares

NCRE integration into the Chilean electricity system: Opportunities for solar enegy, FONDECYT 1141082.
Investigator Responsible Hugh Rudnick
Co- Investigator: David Watts

Proyecto de electromovilidad con la Universidad de Santiago de Chile. Financiado por la Dirección de Gestión Estratégica de la Prorrectoria de la USACH
Director: Javier Pereda

Estudio par ENEL "Infraestructura Nacional de Carga de Vehículos Eléctricos para Chile": Caso Urbano e Interurbano. Centro de energía UC.
Director: Javier Pereda

Direct and Resonant Modular Multilevel Converters for Power Networks, FONDECYT 1171142.
Investigator Responsible: Javier Pereda

EPSRC EP/K036327/1 Reconfigurable Distribution Networks, Imperial College London.
Investigator Associate: Javier Pereda

Operation and Market Models for DER: Facilitating Large Scale Renewable Integration in Chile. Fondo Inicio VRI-PUC.
Investigator Responsible: Matías Negrete

Impacto de Plantas Desaladoras en la Flexibilidad de los Sistemas Eléctricos Chilenos. Proyecto i+d Centro Innovación UC.
Investigador Responsable: Matías Negrete

The SWITCH Model: Analysis of energy policy and technology scenario for Chile Proyecto Corfo 13CEI2-21803.

Investigator Responsible: Matías Negrete

The SWITCH Model: Handling Uncertainty and Power Systems Flexibility. Proyecto Corfo 13CEI2-21803.
Investigator Associate: Matias Negrete

NCRE integration into Chilean electricity system: Opportunities for solar energy, Fondecyt N°1141082.
Co- Investigator: Matias Negrete

Optimization under Uncertainty for Power System Resilience
Director: Alvaro Lorca

Software de Optimización de Limpieza de Plantas Solares Fotovoltaicas.
Co Desarrollador: Alvaro Lorca
Co Desarrollador: Daniel Olivares
Co Desarrollador: Matías Negrete

- **Astroingeniería**

Point Spread function Reconstruction in Tomographic Adaptive Optics, CONICYT 1160236.
Investigator Responsible: Andrés Guesalaga

Chilean Instrumentation for Astronomical Surveys, CONICYT ACT1417.
Investigator Associate: Andrés Guesalaga
Investigator Associate Carlos Jerez
Subdirector: Leonardo Vanzi

National Research Center for Integrated Natural Disasters Management, FONDAP 15110017.
Investigator Associate: Andrés Guesalaga

Reducción de ruido en dispositivos científicos de carga acoplada (para lentes de telescopios o microscopios).
Investigador Responsable: Dani Guzman

Advanced Research in Adaptive Optics for Extremely Large Telescopes, CONICYT 1150369.
Investigator Responsible: Dani Guzman

Internacionalización del Centro de Astro Ingeniería UC, PUC 6822.
Investigator Responsible: Leonardo Vanzi

Research Fellowship in Astronomical Instrumentation at the AIUC, CONICYT-FONDO GEMINI 32130014.
Investigator Responsible: Leonardo Vanzi

An adaptive optic system, pathfinder for the Tokyo Atacama Observatory (OPEN-UC Internacional Seed Funds 2017)
Leonardo Vanzi

- **Electrónica y Comunicaciones**

Modular integrated circuit design and its application in instrumentation circuits for particle physics experiments, FONDECYT 1170345.
Investigator Responsable: Angel Abusleme

Memristive Neural Computing & Learning Architectures (CLeArMeNu), CONICYT 3160042.Investigator Sponsor Angel Abusleme

Sistema de monitoreo de flujo aéreo y alerta temprana de accidentes para pacientes con traqueostomía, Fundación Copec-UC 2015.R.557.
Investigador Alterno: Angel Abusleme

Effects of consumer behavior on agglomeration of competitive facilities , FONDECYT 2016-2019, 1160025.
Investigator Responsible: Vladimir Marianov

Instituto de Sistemas Complejos de Ingeniería (ISCI), Financiamiento Basal FB0816.
Investigador Asociado y Miembro del Directorio: Vladimir Marianov

VDC 12CTI-16788-02: Desarrollo de oportunidades de mejoramiento para la conservación del vino.
Director alterno: Christian Oberli

DALI- Monitor Respiratorio No-Invasivo para pacientes en riesgo de Depresión Respiratoria. CORFO 17ITE2-72695.
Investigador Alterno: Angel Abusleme

Neutrino Astrophysics in Chile. QUIMAL17005.
Investigador: Angel Abusleme"

CCTV AL PIA/Basal FB0821.
Investigador: Angel Abusleme

- **Automatización y Robótica**

Programa Tecnológico Tranque Inclusivo, Monitoreo en Línea de Depósitos de Relaves, Corfo 16PTECMM-66518, proyectos P2 y P5
Director: Aldo Cipriano.
Director Alterno: Felipe Núñez

Supervision and Optimizing Control of Tailings using Emergent Technologies, FONDEF IT16M10012.
Director: Felipe Núñez.
Director Alterno: Aldo Cipriano

Sistema de Análisis de Big Data en Refinerías Electrolíticas para el Mejoramiento de la Automatización y Gestión Operacional: Caso Chuquicamata, FONDEF IT17M10011.
Director: Aldo Cipriano. Investigador Principal: Felipe Núñez

Online Stochastic estimation of inertial parameters for skid-steer movile manipulators in industrial environments FONDECYT 1171760.
Investigator Principal: Miguel Torres

Enhancing Motion performance of Automated Machinery in Agricultural Environments based on Bayesian Estimation Approaches, FONDECYT 1171431.
Investigator: Miguel Torres

Chilean Instrumentation for Astronomical Surveys CONICYT ACT1417.
Investigator Associate: Miguel Torres

Efficient maneuvering of automated agricultural vehicles with ground and environment restrictions.
Coinvestigator: Miguel Torres

National Research Center for Integrated Natural Disasters Management, FONDAP Centro de Excelencia 15110017.
Investigator Associate: Miguel Torres

Distributed Multi-Agent Control for the Internet of Things, FONDECYT 1161039.
Investigator Responsible: Felipe Núñez

Investigación, Desarrollo y Prueba Industrial de la Suite de Monitorización, Análisis y Control de Aglomeración AGLOM, Minera Spence.
Director: Aldo Cipriano

Validar y empaquetar sistema de monitorización y analizador de calidad de variables para el apoyo a la minería, Corfo Innova.
Director: Aldo Cipriano

- **Biomédica y Análisis de Señales**

Sonification of medical data. CONICYT 1161328.
Pablo Irarrázaval

Free breathing 3D Cardiac Multiparametric Magnetic Resonance Fingerprinting, CONICYT.
Coinvestigator: Pablo Irarrázaval

Magnetic resonance imaging technology for aging related diseases: brain, heart and vessels, CONICYT ACT1416.
Director: Pablo Irarrázaval
Investigator Associate: Cristián Tejos
Investigator associate: Claudia Prieto

Radiología Cuantitativa: Reportes Cuantitativos de Grasa Abdominal Total, CONICYT ID15I10284.
Subdirector: Pablo Irarrázaval

Rapid Diffusion Spectrum MRI by Undersampling, FONDECYT, 1141201.
Investigator responsible: Pablo Irarrázaval

Uncertainty Quantification and Advanced Boundary Element Methods for Electromagnetic Wave Scattering Problems, FONDECYT 1171491.
Carlos Jerez

Multi-Mode Energy Harvesting for Future Systems, Notre Dame-UC ND-PUC 201505.
Investigator responsible: Carlos Jerez

Uncertainty quantification in engineering design, TAMU-UC TAMU-UC 201603.
Investigator responsible: Carlos Jerez

Advanced Boundary Element Methods and Computational Uncertainty Quantification in CEM, OPEN-UC OPEN-UC 201603.
Investigator responsible Carlos Jerez

High-Performance Computing for Multiple Traces Formulation, CONICYT C15E0.
Investigator responsible: Carlos Jerez

Improving Quantitative Susceptibility Mapping reconstruction methods based on MRI acquisitions, FONDECYT 1161448.
Investigator Responsible: Cristián Tejos

Radiología Cuantitativa: Reportes Cuantitativos de Grasa Abdominal Total.
Coinvestigador: Cristián Tejos

Non-invasive 3D full-field Quantification of Cardiovascular 4D flow MR images.
Coinvestigator : Cristián Tejos

Free breathing 3D Cardiac Multiparametric Magnetic Resonance Fingerprinting, CONICYT 1161055.
Investigator responsible: Claudia Prieto

Comprehensive Assessment of Coronary and Myocardial Disease with Self-gated 3D Magnetic Resonance Imaging CONICYT 1161051.
Co-investigator: Claudia Prieto

EPSRC Motion Corrected Reconstruction for 3D Cardiac Simultaneous PET-MR imaging: Towards Efficient Assessment of Coronary Artery Disease.

Investigator principal: Claudia Prieto

EPSRC Programme Grant “SmartHeart: Next-generation cardiovascular healthcare via integrated image acquisition, reconstruction, analysis and learning.
Co-investigator: Claudia Prieto

EPSRC Simultaneous PET-MR Modeling and Reconstruction for Imaging Brain Disorders, Co-investigator: Claudia Prieto

EPSRC Computational Collaborative Project in Synergistic PET-MR Reconstruction.
Co-investigator: Claudia Prieto

EPSRC PET-MR Motion Correction Based Purely on Routine Clinical Scans.
Co-investigator: Claudia Prieto

MRC 3D Free-breathing MRI with High Scan Efficiency for Assessment of Cardiovascular Disease: Combining Acceleration and Motion Correction Techniques.
Investigator Principal: Claudia Prieto

Multidimensioanl and multiparametric Quiantitative Cardiac MRI from continuous Free-Breathing Acquisition.
Investigator Principal: Claudia Prieto

Self-Navigated Multi-Contrast and Quantitative Wole Heart 3D Magnetic Resonance Imaging.
Co- Investigator: Claudia Prieto

V. **ACREDITACIONES**

El programa de Ingeniería Civil de Industrias, Diploma en Ingeniería Eléctrica del Departamento de Ingeniería Eléctrica, fue reconocido en 2003 como "Substantially Equivalent Program to programs in the United States" por la Comisión de Ingeniería (EAC) de ABET.

En el año 2017 el programa de Ingeniería Civil de Industrias, Diploma en Ingeniería Eléctrica fue sometido a evaluación por ABET para una nueva acreditación, resultando acreditado por la Comisión de Ingeniería (EAC) de ABET, hasta el 2021.

El Programa de estudios de Pregrado, conducente al título de Ingeniero Civil Electricista, fue acreditado (Marzo de 2005) por la Comisión Nacional de Acreditación de Pregrado (CNAP), por el período máximo de 7 años (hasta el 15 de Marzo de 2012).

El Programa de estudios de Pregrado, conducente al título de Ingeniero Civil de Industrias con Diploma en Ingeniería Eléctrica, fue acreditado (Marzo de 2005) por la Comisión Nacional de Acreditación de Pregrado (CNAP), por el período máximo de 7 años (hasta el 15 de Marzo de 2012).

Desde Agosto de 2013 se encuentran acreditados por la Agencia acreditadora de Chile A & C, los títulos profesionales de Ingeniería Civil Industrial con Diploma Académico en Ingeniería Eléctrica por 7 años (hasta Agosto del 2020); y el de Ingeniería Civil Electricista por 7 años (hasta Agosto del 2020).

El Programa de Magister en Ciencias de la Ingeniería área Ingeniería Eléctrica fue re-acreditado por la Comisión Nacional de Acreditación (CNA) por un plazo de 6 años, período que culmina el 28 de febrero de 2018. El programa de Doctorado en Ciencias de la Ingeniería, área Ingeniería Eléctrica ha sido acreditado por la Comisión Nacional de Acreditación (CNA), por un período de 5 años comprendido entre el 25 de noviembre de 2015 hasta el 25 de noviembre de 2020.

VI. **TITULADOS DE INGENIERIA ELECTRICA**

- **Doctorado en Ciencias de la Ingeniería**

Arrieta Pellegrin Cristóbal Ignacio
Bustos Sölch Cristian Pablo
Marambio Granic Rodrigo Eduardo

- **Magister en Ciencias de la Ingeniería**

Avilés Arias Camilo Maximiliano
Dauvin Gutiérrez Louise Chantal
González Troncoso Rodrigo Adolfo
Maluenda Philippi Benjamín
Ortega Soto Javiera Constanza
Paredes Lizama Fabián Tomás
Pickenpack Morales Felipe Salvador
Valenzuela Meza Alan Bastián
Velásquez Guerino Constantin Sebastián
Villanueva Casado Constanza Javiera

- **Ingeniero Civil Electricista**

Burstein Gray Marcelo Bernardo
Céspedes Fernández Ives Nicolás
Dauvin Gutiérrez, Louise Chantal **
Esparza Cabrera Daniela Alejandra
González Troncoso Rodrigo Adolfo **
Kipreos De la Fuente Andrés Dimitri
Ljubetic San Martín Constanza Verónica
Marfán Rojas Sofía Lucía de Lourdes
Muñoz Nazal Daniela Alejandra
Ortega Cancino Paula Patricia
Ortega Soto Javiera Constanza **
Paredes Lizama Fabián Tomás
Pereira Rivas Javier Eduardo ****
Pickenpack Morales Felipe Salvador **
Ramírez Armijo Tomás
Ramírez Niño Sebastián Andrés
Rodríguez Molina Juan Ignacio
Vial Allende Carlos Aníbal
Yunis Misleh Víctor Andre ****
Zepeda Navea Alejandro Daniel

- **Ingeniero Civil de Industrias, Diploma en Ingeniería Eléctrica**

Alamos Aste José Ignacio
Alfaro Gómez Jorge Luis
Armas Sáenz Juan Pablo
Avalos Agar Sergio Andrés
Avilés Arias Camilo Maximiliano **
Calderón Bessi Héctor Andrés ****
Cameron Díaz Felipe Andrés
Córdova Sota Samuel Alejandro
Díaz de Valdés Williamson Santiago Andrés
Errázuriz Bulnes Cristóbal
Fraissinet Pierre */***
Haddad Del Villar Christian Alejandro
Heck Oliva Ignacio Andrés
Hidalgo Fadic Daniel Esteban
Hosiasson Retamal Matías Felipe
Irarrázabal Balazs Daniel José
Larenas Lolas Nicolás Alejandro
López Kelly Nicolás Agustín
López Radtke José María
López-Estévez Guerra Matías José **
Maturana Almarza Cristóbal
Mayol Brierley Roberto
Meneses Ramos Alvaro Julián
Miralles Moreira Lorena Alejandra
Molina Sourdat Francisco Javier
Núñez Valdés Hugo Patricio
Orrego Alday Felipe Alonso
Osorio Mardones Sergio Andrés
Pérez Zavala Rodrigo Andrés **
Pérez-Cotapos Ferrada Víctor **
Ramírez Rodríguez Fernando Jesús
Reineking De Camino Karl Dieter
Rogeau Antoine */***
Soto Brunetto Sebastián Andrés
Tapia Tapia Misael Alonso
Terzolo Narea Gianluca
Toro López Cristián Ernesto
Torres Kurth Rafael Martín
Valenzuela Alvarez Diego Andrés
Varela Guzmán Benjamín Samuel
Velásquez Guerino Constantín Sebastián Klaus *
Villegas Belmar Ignacio Andrés
Zepeda Moreno Sergio Ignacio

* Alumnos que recibieron el grado Magíster en Ingeniería
** Alumnos que recibieron el grado Magíster en Ciencias de la Ingeniería
*** Alumnos que recibieron doble título con Grande École, Francia
**** Alumnos que recibieron doble título con Politécnicos, Italia

VII. **PROFESORES VISITANTES**

Visita del Profesor Ricardo Aguilera de la University of Technology Sydney (UTS) en el marco de colaboración con el Profesor Javier Pereda y su grupo de investigación.

Visita de Johannes Garttner, invitado del Karlsruhe Institute of Technology (KIT), quien ofreció un seminario de postgrado.

Visita de Ian Underwood de la University of Edimburgo, durante la visita impartió el curso Design for Manufacturability 27-28 de marzo

Visita de la delegación de la Universidad Nacional Altiplano de Puno, 23 de noviembre de 2017

VIII. ACTIVIDADES INTERNAS Y DE DIFUSION

Se desarrollaron diversas actividades de difusión de los programas académicos y actividades sociales con alumnos y profesores:

- **Ciclo de Charlas de Postgrado.**

El objetivo es que todos nuestros alumnos de postgrado exponen sobre un tema de su interés o su avance en la investigación que realizan, y también de cierta manera que los alumnos de pregrado, los cuáles también son invitados, puedan conocer lo que se está investigando en cada área del Departamento. La charla es una instancia de comunicación al interior de nuestro Departamento, para que entre todos los alumnos haya un feedback entre las distintas áreas de investigación a las cuales pertenecen.

Durante el año 2017 se realizaron 28 charlas (14 el primer semestre y 14 el segundo semestre), las que contaron con un gran número de asistencia, tanto como alumnos de pre y postgrado.

- **Feria de Orientación Académica 2017**

La Escuela realiza la Feria de Orientación Académica. El departamento está representado por un stand, en donde nuestros profesores y alumnos orientan, con el objetivo que cada alumno reciba información relevante acerca del departamento de Ingeniería Eléctrica, sobre el plan de estudios, diplomas y especialidades, líneas de investigación, perfiles de egreso, entre otros.

- **Actividades de profesores**

El profesor Angel Abusleme realizó las siguientes actividades:

Realizó la charla "Física… una mirada desde la Ingeniería" en el Colegio San Viator, 24 de mayo de 2017

Realizó charla "Física… una mirada desde la Ingeniería" en colegio República de Siria, 26 de septiembre de 2017

Realizó charla "Ingeniería en la búsqueda de Neutrinos y el Bosón de Higgs" en Expo Futuro Novato el 5 de octubre de 2017

Realizó charla "Ingeniería en la búsqueda de Neutrinos y el Bosón de Higgs" en Encuentro Científico UC, 17 de octubre de 2017