# Proyectos STIC AmSud – convocatoria 2017

## CoDySCo2 - Control of Dynamical Systems under Communication Constraints

Abstract
This project focuses on the development of methods and techniques for analysis and design of dynamical control systems to cope with constraints induced by communication constraints between sensors, actuators and dynamical plants. The motivation for this study comes from the fact that most of control systems operates over a communication network (the so-called networked control) or involves traffic of information over a communication channel. In this scenarios, the effects of communication delays, packet losses, heavy temporary load of computation in a processor, aperiodic sampling, battery consumption (e.g when wireless communication is concerned) and data quantization, must be take into account in the closed-loop systems. Neglecting these communication- induced constraints can lead to considerable performance degradation or even unstable behaviors, with economic or catastrophic consequences. The main goals of this project concern the proposition of new methods and techniques of analysis and control design in order to cope with the aforementioned communication constraints. In the analysis context, the methods should provide efficient computational tools to assess stability and performance of closed-loop systems in the presence of communication delays, aperiodic sampling, data packet losses and signals quantization. These tools must be able to quantify admissible delays, maximal inter-sampling intervals and quantization coarseness for which stability of closed-loop systems is preserved and performance degradation is kept under admissible levels. Regarding the synthesis, methods should take explicitly into account for, during the control law design, the communication delays, the number of bits for coding information, data losses and aperiodic sampling in order to satisfy stability and performance requirements. To achieve these goals the methodology will be based on appropriated models of the dynamic systems (linear and nonlinear) as well as of the communication phenomena (delays, packet losses, quantization, aperiodic sampling, etc.). The theoretical developments will

be based on the Lyapunov theory for linear, nonlinear and hybrid systems. Stability and performance results should be formulated mainly as linear matrix inequalities allowing to cast them in convex optimization problems aiming to compute maximum allowable delays and sampling intervals to ensure the stable behavior, compute minimal number of bits to guarantee stability and a certain performance, estimate regions of attraction (for nonlinear systems), or even, compute the controller parameters in order to maximize the admissible delays, reduce control updating (in event-trigger strategies, for instance), maximize the region of attraction, among other optimization criteria.

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## DAJA - Detection strategies based on Software Metrics for Multitier JavaScript

Abstract

JavaScript is the most popular object scripting programming language. It is extensively used in web pages, servers, and web applications, among others. While JavaScript was initially conceived only for scripting, it is frequently used in large applications. The rapid adoption of JavaScript has outpaced the Software Engineering community to propose solutions to ensure a satisfactory code quality production. This situation has favored the production of poor quality JavaScript applications: we have found across JavaScript applications a large presence of dead-code (i.e., source code portion that is never used) and code duplications. These symptoms are known to lead to maintenance and performance degradation. Moreover, we have previously analyzed potential security threats to JavaScript applications produced by bad coding practices [18].

The DAJA project will provide methodologies, techniques, and tools to ease the maintenance of software applications written in JavaScript while improving its security. DAJA is structured around two sequential phases:

* In a first phase, we will provide an open JavaScript meta-model that exhibit structural properties and supports software metrics. Polymetric views are a family of software visualizations in which software metrics are mapped to a software structure. We will associate polymetric views to our meta-model as a foundation of DAJA.
* In a second phase, we will build analyzing tools to identify different sources of code anomalies (i.e., portion of code contributing to technical debt [8]) and vulnerable code (i.e., portion of code that are potential security threats). Specifically, we will identify, measure, and characterize two attributes known to contribute to the software quality deterioration: dead code (i.e., portion of code that is never exercised for a given set of program execution), and the top ten OWASP vulnerabilities1 (a consensus of the most critical web application security aws). We also plan to identify other types of anomalies that can affect the architecture of the applications.

The produced analyzing tools will be evaluated on a representative corpus of JavaScript applications. Moreover, our analyzing tools will be designed to be extensible. In particular, our tools will operate with the Hop.js JavaScript engine. Hop.js is an extension of JavaScript in which a single code portion may execute on the client and the server. Applying our techniques to Hop.js will increase our visibility and exposes our analyzes to industrial partners. The research areas explored by DAJA are new within the context of JavaScript. The software artifacts produced by DAJA will be available under an open-source license. Three research teams will collaborate on DAJA: (i) the INDES project, based in INRIA Sophia-Antipolis, having an expertise in JavaScript engine and web application security; (ii) the ISIS-TAN institute, based in Argentina, having an expertise in identifying and prioritizing code anomalies; (iii) the Pleaid laboratory, based at the University of Chile, having an expertise in software visualization and JavaScript analyzing.

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## EMPATIA - EMotional Pedagogical Agents for Training, Instruction and leArning

Abstract

This project aims at combining the Brazilian, Argentine and French investigation teams’ expertise in Artificial Intelligence applied to Education and Virtual Agents to investigate the impact of the *expression of social attitudes* (i.e., friendly, unfriendly, dominant, submissive) of virtual agents, depending on their social role, on students behavior and learning and also on students perception of the agent. A model of social attitudes can increase the believability of the virtual agent, change the difficulty of the training, and therefore more successfully engage students. Besides, the expression of social attitudes by an agent can impact on how learners perceive the agent. As it occurs in human-human interaction, the learner may interact differently depending on the agent’s social attitude. Although other works have investigated how to express social attitudes on virtual agents by verbal (i.e., dialogue) and nonverbal (i.e., expression of emotions by face and by gesture) behavior, we are not aware of research that has been specifically interested in how the social attitude of a virtual characters impacts on students' behavior and learning, especially when these agents are exercising different social roles (for example, tutors, companion, etc). For empirical evaluation, we are going to integrate the computational model of social attitude developed by the French team, SOCRATES, into the animated pedagogical agents. The agents are integrated into two learning environments developed by the Brazilian and French teams, respectively: (i) PAT2Math (http://pat2math.unisinos.br), a step-based ITS that provides step-by-step assistance for K12 students in the process of solving first degree equations; and (ii) Acorformed System, a platform to train doctors to break bad news with a virtual patient. While in PAT2Math the animated agent is going to play the role of a tutor, in Acorformed (http://www.lpl-aix.fr/~acorformed/) it is going to play the role of a simulated patient.

This will allows us to investigate the impact of several social attitudes of pedagogical agents playing different roles on learning environments (i.e., a friendly versus an unfriendly tutor with a friendly versus unfriendly simulated patient) on students’ behavior (i.e., gaming the system) and learning (performance).

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## GENE - Stochastic dynamics of large games and networks

Abstract

Through the creation and consolidation of strong research and formation exchanges between Argentina, France and Uruguay, the GENE project will contribute to the fields of performance evaluation and control of communication networks, using tools of game theory, probability theory and control theory.

Some of the challenges this project will address are:

- Mean-field games and their application to load balancing and resource allocations,

- Scaling limits for centralized and decentralized load balancing strategies and implementation of

practical policies for web servers farms,

- Information diffusion and communication protocols in large and distributed wireless networks.

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## HyperMed - Image reconstruction from compressed measurements: application to hyperspectral and medical imaging

Abstract

Introduced in 2006, the compressed sensing (CS) theory guarantees an exact recovery of specific signals from fewer measurements than the number predicted by the Nyquist limit. This guarantee is obtained for sparse signals (or having a sparse representation in a given basis or frame) and is based on incoherent measurements that generalize the concept of samples in the standard sampling scheme. Since its introduction in 2006, CS has received much attention from the scientific community as shown by the impressive number of journal papers, conferences and workshops on this topic. In particular, it has been shown that several applications can benefit from CS, such as image and video processing, communications, radar, biology or astronomy. Despite solid theoretical background, its application to practical image processing problems (such as those related to hyperspectral and medical imaging addressed in this project) remains an open research problem. This project will be the opportunity to gather researchers from different communities, i.e., medical imaging, hyperspectral imaging and statistical signal processing, with the main objective of bringing CS closer to hyperspectral and medical imaging by developing new methodological approaches meeting the practical constraints specific to each application.

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## MOPAIOSIP - Ontological and metamodelling support for collaborative business processes in a Process-Aware Inter-organizational Service-Based interoperability platform for e-government

Abstract

A key motivation for the project is that interoperability across heterogeneous organizations is a complex task, where a key element to enable real collaboration between them is to define without ambiguity the concepts that are involved and their relations. Integrating this knowledge and information in an interoperability platform allows participants to connect their own solutions to the software provided by the platform, in an easier way. Previous works from the participant research groups have dealt with ontologies and metamodels for crisis management, interoperability platforms definition, collaborative processes modeling and execution in BPMS platforms, processaware information systems, and e-government solutions. The results of the project will integrate existing knowledge and previous works from the participant research groups, generating a more complete, integrated and robust proposal to be used as basis for inter-organizational collaboration in the e-government domain. Also this project aims at promoting future collaborations for other domains such as health, education, among others.

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## MOTIf - Mobile phone sensing of human dynamics in techno-social environment

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| AbstractInformation and Communication Technology (ICT) is becoming increasingly social, as demonstrated by the multitude of emerging technologies and technology platforms that facilitate social interactions, taking place as communication via telephone, text message, email, online social networks etc. At the same time, our social activities are increasingly embedded in the ICT environments that enable and enhance our ability to transact, share experiences, and maintain social relationships.One of the best ways to explore these developments is through the mining and analysis of data, which are collected through mobile phones and allow us to investigate how individuals act when embedded in a technology-enabled environment. Unlimited access to a wide range of mobile applications and services may change our way to gain information, to communicate, or even to behave in different contextual places like home, work, or anywhere else. Thus understanding individual activity patterns and the source of decisions behind them is moreover important for the design of future services and to estimate the demand on the infrastructure. The MOTIf project builds on the analysis and modeling of geo-localized temporally detailed but fully anonymised mobile phone call networks. These datasets allow us to address the two scientific objectives about spatiotemporal patterns of service usage of anonymised individuals to learn when, where, and what people are doing; and about the fine-grained sociodemographic structure of society and its effect on the the individual social behaviour. In other words our goal in general is to understand how individuals behave in a dynamic techno-social environment.Institutions and scientific coordinators: |
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## StaRel - Statistical Relational Learning for Music Information Extraction and Expressiveness Studies from Audio Recordings

Abstract

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| The development of computer hardware technology and the proliferation of online music collections have sustained the development of Artificial Intelligence techniques for music research in several directions, fostering new interdisciplinary research opportunities. This interdisciplinary research project aims to develop innovative technological and music-analytical methods to gain fresh insight into the understanding and modeling of the rhythmic/metrical structure in audio recordings of expressive music performances. For this, we will explore the use of some new frameworks developed in the statistical relational learning area that have recently opened perspectives to model the complex relational structure of musical data. While the approaches we propose are common to any style of music, we exemplify our methods via an analysis of new datasets of Latin American music, bringing new musicological insight into some musical genres that have not yet been explored by the Music Information Retrieval research community. We will also provide the music research community with new annotated data and software ressources.

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## TRANSFORM - Transforming multimedia data for indexing and retrieval purposes

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| AbstractMultimedia data are usually complex, possibly combining multiple channels and time information to convey a message. It is highly dimensional, multimodal, and involves variability and distortion. In this project, we aim at studying and designing different transformations of multimedia data that enables to facilitate its manipulation, while handling the different particularities stated above.TRANSFORM focuses on transforming multimedia data into compact representations that are suited for indexing and retrieval purposes. We will design particularly transformations adapted to 3Dshapes, temporal data and to multimodal data. The designed representations will be integrated into efficient indexing schemes for retrieval purposes. Targeted applications will include 3D-shapes indexing, discovery of audiovisually coherent fragments, of recurrence in speech data and multimodal content linking and navigation. This project will strengthen existing collaborations between Brazilian, Chilean and French labs, all having a strong background in multimedia content analysis. We will also establish exchange of students so that these collaborations can pursue in the future.Institutions and scientific coordinators:Silvio Jamil F. Guimarães, Pontifícia Universidade Católica de Minas Gerais - PUC Mina, BRASILArnaldo de Albuquerque Araújo, Universidade Federal de Minas Gerais – UFMG Computer Science Department, BRASIL Benjamin Bustos, Universidad de Chile Department of Computer Science (DCC), CHILESimon Malinowski, CNRS, Institut de Recherche en Informatique et Systèmes Aléatoires– IRISA, FRANCIA  |
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