ADAPTIVE SYSTEMS LABORATORY

Contact details

<table>
<thead>
<tr>
<th>Name</th>
<th>Adaptive Systems Laboratory</th>
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<tr>
<td>Acronym</td>
<td>ASL</td>
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<tr>
<td>Logo</td>
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<tr>
<td>Site</td>
<td><a href="http://asl.utcluj.ro/asl">http://asl.utcluj.ro/asl</a></td>
</tr>
<tr>
<td>Address</td>
<td>2 Observatorului Str., room 2, Casa Radio, lab 406, 400089, Cluj-Napoca, Romania</td>
</tr>
<tr>
<td>Faculty</td>
<td>Faculty of Electronics, Telecommunications, and Information Technology Communications Department</td>
</tr>
<tr>
<td>Department</td>
<td>Communications Department</td>
</tr>
<tr>
<td>Telephone</td>
<td>+40 264 401813</td>
</tr>
<tr>
<td>Fax</td>
<td>+40 264 401917</td>
</tr>
<tr>
<td>Director</td>
<td>Assoc. Prof. Dr. Eng. Marcel Cremene</td>
</tr>
<tr>
<td>e-mail</td>
<td><a href="mailto:cremene@com.utcluj.ro">cremene@com.utcluj.ro</a></td>
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Areas of expertise

Our laboratory has two main research domains: **Mobile Computing** and **Cognitive Communications**. Cognitive Communications is a new, cross-disciplinary enterprise that brings together the field of communication techniques and computational intelligence, aiming to revolutionise the way wireless communication devices and networks behave through 'intelligent' assignment of resources and operation. 'Cognitive communications' requires a multi-disciplinary approach, bringing together the established areas of: Wireless communications, Distributed artificial intelligence, Electromagnetics, Regulatory policy and economics, Implementation. Other related domains are: Optimization methods and techniques for telecommunications, Computational game theory applied to telecommunications, Context-aware mobile computing, Web service composition and adaptation, Adaptive (smart) antennas, Microwave antennas and circuits and Affective computing.

Team and key skills

**Assoc. Prof. Dr. Eng. Marcel Cremene**
Mobile Communications, Mobile Computing, Software Engineering, Adaptive Systems, Artificial/Computational Intelligence (artificial neuronal networks, evolutionary algorithms, optimization techniques) and Computational Game Theory applied in Telecommunications.

**Assoc. Prof. Dr. Eng. Nicolae Crișan**
Adaptive antennas, Microwave circuits, Computer aided design for microwaves and Radio communications.

**Assist. Prof. Dr. Eng. Ligia Cremene**

**Assist. Prof. Dr. Eng. Iulian Bența**
Affective computing, Mobile Computing, Data mining.

**Dr. Eng. Mihai Alexandru Suciu**
Optimization, Game Theory, Mobile Computing.

Infrastructure

SDR platform (Software Defined Radio), spectral analyzer, oscilloscope, wireless routers 802.11a, b, g, n, wireless adapters, simulation server, wireless design and simulation software, programmable mobile devices (smartphone, PDA, GPS receiver, etc.), smart antenna (MIMO) testbed, antennas (various types, including arrays), TI reconfigurable radio boards, mobile smartphones.
Development strategy

Our research activities are focused on problem solving, optimization, and decision making in various adaptive systems. Similar adaptation principles apply to both hardware and software systems. Cognitive Communications and Distributed Mobile Computing are our main fields of development. We put a large amount of effort in maintaining and developing our international collaborations with teams from France, Slovenia, Belgium, Latvia, and Canada, working together in projects like Brancusi, ECO-NET, COST, and CREW.

Representative projects


A first issue addressed by this project concerns the development of a system capable of service composition and dynamic adaptation. This requires aggregating different types of information that define the context: user request, the physical and social context, available resources, etc. A second issue concerns the problem that is related to the fact that, in composition and adaptation services, is often required a multi-criterial optimization. The maximization of the service quality parameters, QoS, should be done simultaneously with the minimization of other parameters concerning the resource consumption and costs. A third issue addressed in this project is to implement a distributed composition and adaptation mechanism.


The developed models address the problem of efficient use of radio spectrum and that of complexity management in flexible radio interfaces. The models are based on concepts and instruments from computational game theory, optimization and evolutionary algorithms.


Autonomic computing is a very ambitious domain dealing with issues such as system self-management, proactive services and adaptation to unpredicted situations. We propose an autonomic adaptation platform. The key aspect of our proposition is a dynamically updatable service-context meta-model that enables the adaptation platform to diagnose the service adequacy to its context and automatically search for solutions in order to correct the inadequacy.


The objective of this project is the development of a system capable of service composition and dynamic adaptation. This requires aggregating different types of information that define the context: user request, the physical and social context, available resources, etc. A second issue concerns the problem that is related to the fact that, in composition and adaptation services, is often required a multi-criterial optimization. The maximization of the service quality parameters, QoS, should be done simultaneously with the minimization of other parameters concerning the resource consumption and costs. A third issue addressed in this project is to implement a distributed composition and adaptation mechanism.


The purpose of the Project is to set the basis of the conceptual integration of Artificial Intelligence, Game Theory, and Decision Theory. The objectives concern the development of new tools that will enable scientists and practitioners to surpass field insularity and solve real-world problems.

Significant results

The most representative publications of the past 5 years

ISI journal papers, ISI proceedings, Books & book chapters, Patents:

10. L. C. Cremene, D. Dumitrescu, "Analysis of Cognitive Radio Scenes Based on Non-cooperative Game Theoretical Modelling", IET Communications, pp. 1876-1883, October 2012 [FI = 0.329]

The offer addressed to the economic environment

<table>
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<tr>
<th>Research &amp; development in core areas</th>
<th>Cognitive communications - resource sharing models, energy efficiency Optimization models and algorithms for telecommunications Experimental game theoretical models Context-aware mobile computing Smart antenna algorithms (including MIMO)</th>
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<tr>
<td>Consulting</td>
<td>Mobile computing Artificial/Computational Intelligence applications Decision making support, game theoretical analysis Technical writing (technical specifications, project proposals, patents) Antenna design (including MIMO) Radio network planning (optimization methods) IEEE 802.22 cognitive radio wireless standard and other wireless standards</td>
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### Applied engineering services

- Software engineering, design patterns
- Decision making support analysis
- Antenna design
- Radio measurements

### Training

- Mobile computing (J2ME, Android)
- Artificial/Computational Intelligence applications
- Design and simulation software for wireless communications, including antennas:
  - HFSS - High Frequency Structure Simulator.

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**Fig. 1** Experimentation of radio resource sharing models for energy efficient wireless networks. Simulation related to cognitive radio, dynamic spectrum access - game theoretical approach.

**Fig. 2**: MIMO smart antenna testbed access - Game Theoretical approach.

**Fig. 3**: TI Smart Radio boards (Cognitive Radio devices).

**Fig. 4**: Android application - location based.