

Computing Research Center (CIC-IPN)
Instituto Politecnico Nacional, Mexico





CIC-IPN

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Postgraduate Programs





The Computing Research Center (CIC-IPN)

offers programs of the highest academic standard in Mexico.

The Computing Research Center (CIC-IPN) graduates professionals at the Master of Science level in computer, electrical and electronic engineering, providing high quality education to students interested in acquiring new knowledge in the fields of nanotechnology and microtechnology, hardware and software, including innovative combination of these disciplines to resolve new challenges in the area of engineering. At the doctoral level, the Center welcomes graduate professionals interested in deepening their knowledge in the theory and techniques of modern computing and making original contributions in the area.

PhD in Computer Science

The advance of Information and Communication Technology has a strong impact on the development of virtually all productive sectors and most areas of science. This program addresses the existing backlog of researchers in the field of computer science and of scientists conducting basic and applied research for the benefit of strategic sectors and necessary in the current process of modernization.

Objective:

Prepare human resources of academic excellence at the doctoral level, professionals with a deep knowledge in Computer Science, according to the highest international standards of quality and competitiveness, to generate new knowledge in the areas of computer science and computer engineering.

Postgraduate Programs

MSc in Computer Science

The program is designed to fit the context in which societies evolve and develop together making proper advances in the field of Information and Communication Technology. Under this global scenario, this program stimulates innovative thinking of the students to be graduated giving them a high level training in information technology for scientific research and technological development.



Objective:

Prepare high level specialists to implement, innovate, develop and apply new technologies in computer science, participating as work groups leaders solving problems within public and private sectors.

Postgraduate Programs

MSc in Computer Engineering

The program is relevant to address the technology gap in development and technology transfer related to special purpose and high performance computer systems, including disciplines related to technological innovation such as nanotechnology and microtechnology. The program was created in response to the lack of specialists able to meet the technological needs of industries and strategic sectors, essentially, to foster modern economic development.

Objective:

Prepare high level students capable of developing advanced computer systems while strengthening creativity and technological innovation, working in a spirit of leadership in solving engineering problems which involve design, analysis and implementation of devices and system processes.

MSc in Computer Engineering considers the design and use of computing components, software or hardware, or a combination of both, for solving technical problems in an efficient and competitive way.



CIC Academic Programs and Graduation Rates

Two earlier centers supported the Computing Research Center (CIC-IPN) foundation:

- In the first place, the National Calculus Center of the IPN (CeNaC) created in 1963; this Center offered the first Master of Science program in Computing in Mexico.
- The Technological Research Center in Computation of the IPN (CINTEC) founded in 1988, this Center offered the Master in Computing Engineering.

The Computing Research Center (CIC-IPN) was founded in 1996, since that year it has been offering three postgraduate programs: MSc in Computer Science, MSc in Computer Engineering and PhD in Computer Science.

Students enrolled in the postgraduate programs at CIC-IPN, December 2015.

Postgraduate programs certified by (CONACyT)	Students
Master in Computer Science (MCC)	89
Master in Computer Engineering (MCIC)	57
PhD In Computer Science (DCC)	57
Total	203

Total of graduates on the CIC programs at December 2015.

Graduate levels, since 1996	Total
Master of Science (MCIC, MCC)	627
Ph Doctor (DCC)	127
Total of graduates	754



Research Lines at CIC

Professors' profile


The National System of Researchers (SNI-CONA-CyT) has certified and recognized 29 of our professors as members due to the research work done at CIC-IPN.

There are 52 full-time professors involved in the research activities of the CIC-IPN programs, 82.7% of the staff has the PhD degree.

Research Lines at CIC

Artificial Intelligence 

Network and Data Science 

Data Science and Technology Software 

Digital Signal Processing 

Geospatial Information Intelligent Processing Laboratory 

Microtechnology and Embedded Systems 

Modeling and Simulation 

Natural Language and Text Processing 

Intelligent computer 

Intelligent Systems for Automation 

Robotics and Mechatronics 

Cybersecurity 



MICROSE-Lab workshop

Relevant Aspects



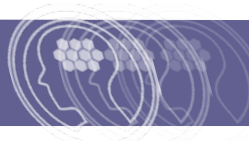
The Computing Research Center CIC has a highly qualified staff; 66% of its researchers are certified by the Mexican National System of Researchers.

The Computing Research Center CIC has adequate facilities and modern laboratories with proper equipment; it also enjoys the cooperation and support of the Center for Nanoscience and Micro- and Nanotechnology of IPN, Mexico.

Students may carry out research abroad, in foreign institutions, complementing research for their theses.

The Computing Research Center CIC has a specialized library with more than 14,000 titles, with access to the most important databases of electronic books and journals.

CIC also edits the “Computación y Sistemas” journal of Iberoamerican coverage, included in the Mexican Scientific Research and Technology CONACyT Journal Index, and in the ISI and SCOPUS international database.

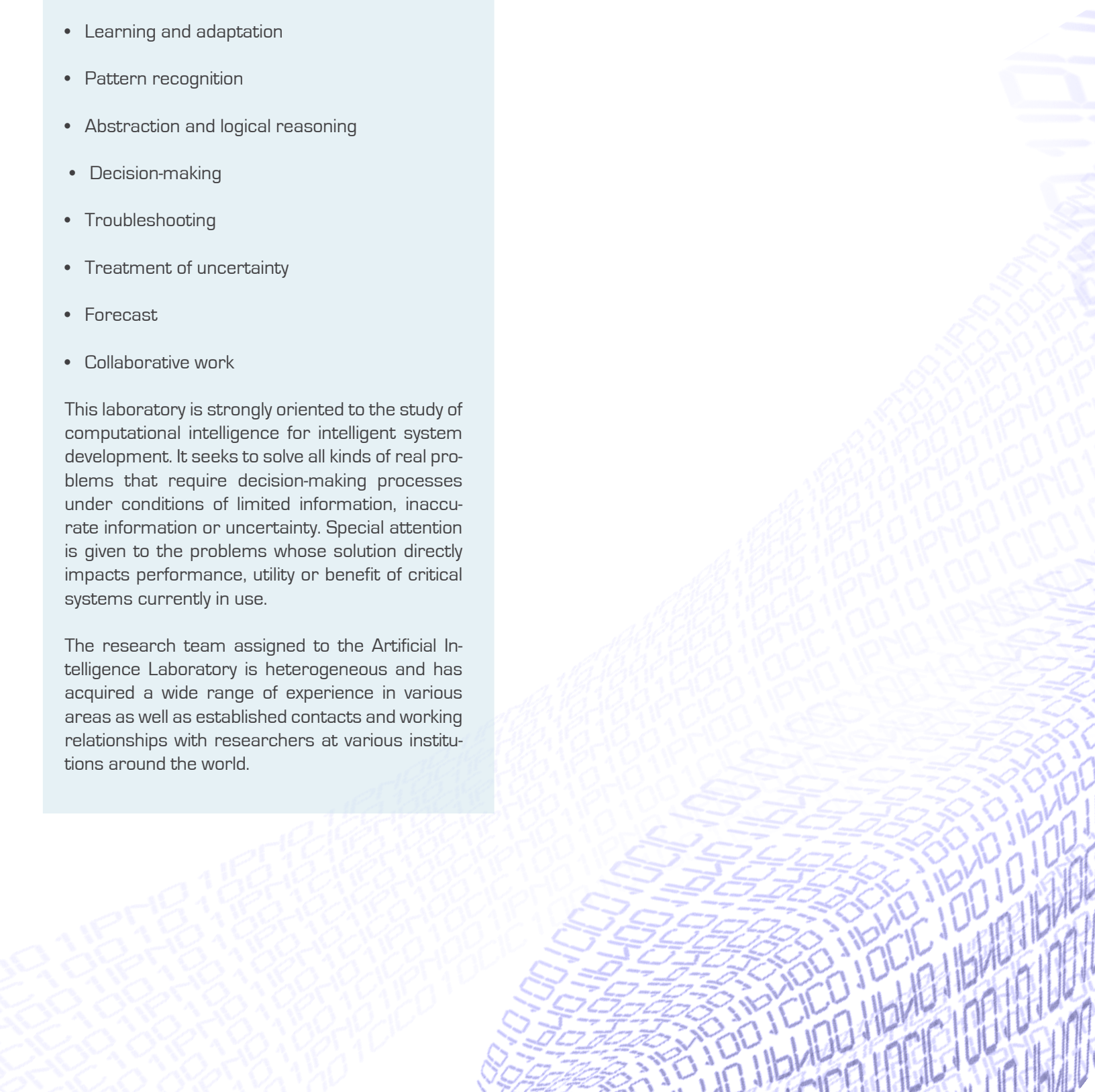


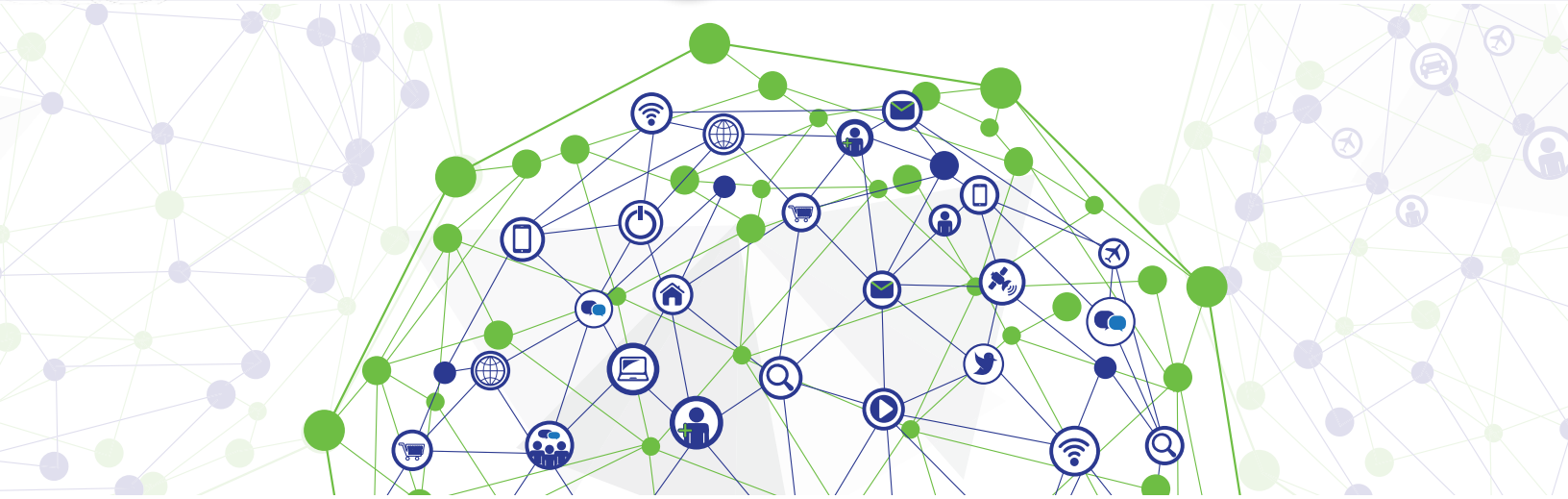
Artificial Intelligence is traditionally known as the discipline that seeks to provide computers with many capabilities that we identify with our own intelligence, such as:

- Learning and adaptation
- Pattern recognition
- Abstraction and logical reasoning
- Decision-making
- Troubleshooting
- Treatment of uncertainty
- Forecast
- Collaborative work

This laboratory is strongly oriented to the study of computational intelligence for intelligent system development. It seeks to solve all kinds of real problems that require decision-making processes under conditions of limited information, inaccurate information or uncertainty. Special attention is given to the problems whose solution directly impacts performance, utility or benefit of critical systems currently in use.

The research team assigned to the Artificial Intelligence Laboratory is heterogeneous and has acquired a wide range of experience in various areas as well as established contacts and working relationships with researchers at various institutions around the world.





The Network and Data Science Laboratory (NDS-Lab) at the Computer Research Center of the National Polytechnic Institute. Our group is dedicated to basic and applied research in complex networks, distributed combinatorial optimization and mathematical modeling with applications to computer networks and machine learning.
<http://www.prime.cic.ipn.mx/>.



PROBLEM



DATA



ALGORITHMS



KNOWLEDGE

National projects:

- > Algorithm theory (Approximation algorithms, randomized algorithms, distributed and concurrent algorithms).
- > Data science.
- > Internet of everything (IoE).
- > Machine learning.
- > Mobile computing.
- > Peer-to-peer networks.
- > Pervasive computing and crowdsourcing.
- > Wireless networks (BANs, Cellular, MANETs, VANETs, sensor networks).





Research lines

Text processing, knowledge representation, semantic networks, ontologies and semantic processing.

Information systems, software engineering, particularly: requirement engineering, software prototypes, reusability, project management and software quality,

system design with UML modeling, software testing and reliability, web engineering.

Objective

Develop tools, techniques, algorithms and methodologies for information system creation and management.

The Laboratory was organized to develop new tools, techniques, algorithms and methodologies in order to use them for creating and managing information systems and to apply them for satisfying present and future information needs of governmental and private organizations; all the above mentioned are based on innovative schemes that integrate database management, data processing, graphical interfaces, data mining, semantic web, agents and software engineering.

Information and knowledge modeling using texts and images.

Architecture and interoperability in databases (relational, semi-structured and new trends), web databases, web application development, web services, semantic web and information integration.

Administration and refinement of database administration systems, data mining, data processing, data warehouses, OLAP, information visualization, information retrieval and science metrics.

Digital Signal Processing Laboratory prepares high-level specialists able to solve problems related to capture, analysis (feature extraction and their classification), synthesis (production) and digital processing of one- and two-dimensional signals, using and developing specialized devices and software. After completing their studies, graduates can work as professors, researchers, or experts in public sectors related to health, services and technology.

Research lines

Speech recognition

Research along this line is directed towards creation of speech databases (speech corpus) for various purposes such as context free/dependent speech recognition, short sentence recognition (their classification); speech recognition program design for low level applications (movement orders to autonomous robots, voice controlled devices). One project is devoted semi-automatic generation of speech recognition applications, another one applications including training and implementation of spoken language.

- Common and emotional speech synthesis

Development of various types of speech synthesizers for applications.

- Machine translation of speech

Combination of techniques of speech recognition/synthesis with speech corpus for a wide range of applications: from simple ones to community service systems.

SIGNAL/IMAGE COMPRESSION USING SIGNAL ADAPTABLE WAVELET FILTERS

Signal/image filtering using DCT; complex image description invariant to its magnification, using iterative algorithms; image details segmentation using mathematical relations.

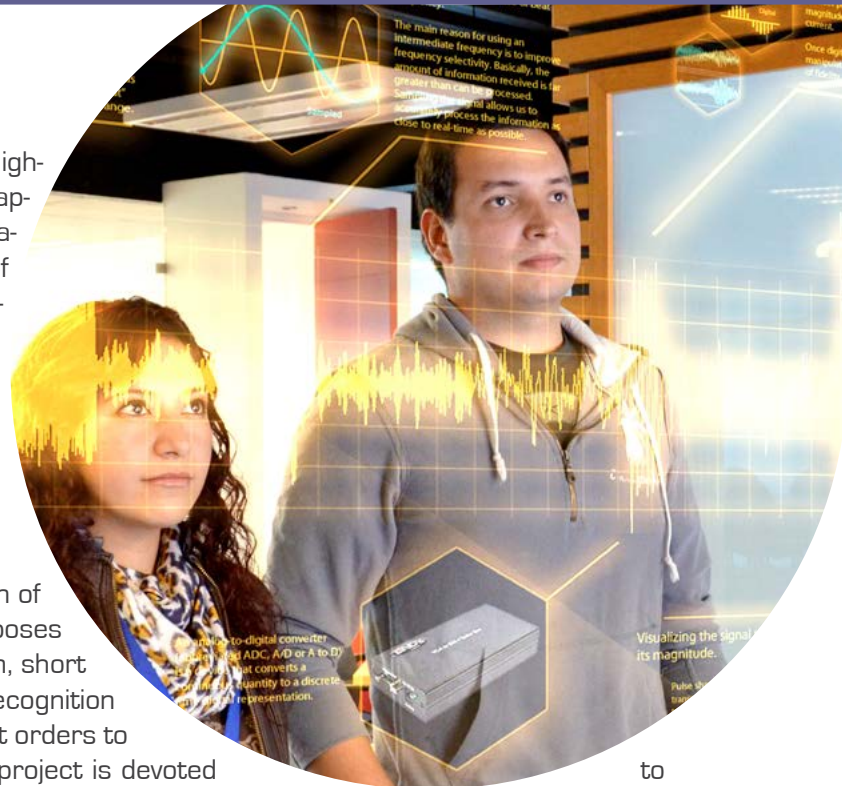
Speech analysis, synthesis, speech and speaker recognition by android operating system on embedded platforms.

Speech recognition applications for electromechanical systems

Synthesis of musical scores by computational means

Human cochlea modeling

Algorithm analysis for hearing aid design



to
to medical

- Speech and emotional text classification

Emotional speech classification constitutes a higher level of speech processing. This research aims to determine the speaker's mood regardless of the language in which it is expressed; this can be used in various applications (medical diagnosis, orders to devices, speech synthesis, etc.).

- Capture, processing and classification of all kinds of sounds and signals

Compilation of sound and signal corpus for subsequent extraction of a set of features, patterns that define a sound/signal or identify its source which may be a person (speaker), a vehicle (land and air), or any other object. This research line is strongly related to signal classification, pattern recognition and artificial intelligence techniques.



MICROSE-Lab Microtechnology and Embedded Systems

Microtechnology and Embedded System Lab is a place in Mexico where students receive high education and training, develop internationally competitive skills in the area of computer engineering.

MICROSE-lab activities are focused on:

- Software Development for Specific Applications
- Micro- and Nanotechnology (MEMS-NEMS)
- FPGA's and Embedded Systems
- Embedded Operating Systems
- Computer Architectures
- VLSI Design



MICROSE Research Programs:

High Performance Computer Architecture:

new ideas to develop low power and high performance microarchitecture and circuits for future processors; simulation, design and integration of high performance and low power circuits for superscalar processors.

Micro- and Nano-Devices:

ideas to develop micro- and nanodevices for specific applications, mainly, specific sensors.

Reconfigurable Computing:

design and integration of application's kernels with high computing demand in programmable modules written in VHDL / Verilog / SystemVerilog to be synthesized in architectures of FPGA's reconfigurable.

Cities with Technology and Connectivity:

ideas to integrate new technologies to improve habitant's comfort.

Alligator Project:

design of a Superscalar Processor (MIPS R10000) using HDL and Mentor Graphics CAD.

Modular Architecture for Synthesized Applications MASA:

a big project that includes such combining work technologies as Operating Systems, Reconfigurable Hardware, Dynamic Reconfiguration, Synthesizers and Hardware Libraries.

HPCA and RC skills:

to develop specific computing skills, CIC has prepared special courses that provide tools and specific training.

The project GUIAME (guide me in Spanish):

administration and control by complex systems of monitoring of smart vehicular traffic, using GPS, GIS, DB's, and Telecommunications: MAN, WiMAX and GPRS, GSM, EDGE (Cellular Network).

Embedded System Design:

integration of SBC, FPGA's, peripherals, appropriated OS and development of software for specific mobile applications.

Courses:	Tools:	Specific Training:
Computer architectures Processor design Systems Programming. Operating System and Hardware Description Languages	Simplescalar-3.0, Cactl-3.0 Alligator-Oro.	VLSI Design CAD; Mentor Graphics, HDL Designer Series, Leonardo Spectrum, ModelSim, Questa, Certe, Tanner and Hspice

Courses:	Tools:
Computer Architectures Systems Programming, C, C++, Java Operating System HDL	Simulators, Bosh, Qemu, VM, Linux Open Embedded Android, Meego Windows, Windows Embedded WindowsPhone7



**Microtechnology Facilities.
Characterization Laboratories**

- Microscopy:
Laser Scan, Atomic Force
- Spectrometry:
RAMAN, Ellipsometer

**Clean rooms: Class 100 and 1,000
Equipment:**

- RIE-Reactive Ion Etching
- Sputtering
- Mask Aligner EVG320



Research network in building sensors and biosensors

Research fields	CIC IPN Networks
Food sciences	Micro and Nanotechnology Network
Health sciences	Biotechnology Sciences Network
Strategic research in Energy	Mexican Petroleum Institute (IMP)

Micro- and Nanodevice Design Skills

Courses:	Tools:
Analog IC Design Advanced Analog IC Design Low power Design Analog Signal Processing Modern Physics Multiphysics Simulation	H-SPIICE, Tanner, (LEDIT, SEDIT, LVS) Mentor Graphics HDL Designer Series Leonardo Spectrum ModelSim Questa Certe COMSOL SUMMIT V





Research lines

- Geospatial domain analysis and semantic processing
- Geographic information retrieval
- Applications of similarity in the geographical context
- Semantic integration of heterogeneous data sources
- Passive and active monitoring of urban environments based on mobile GIS applications and web

Basic and applied research projects:

- Analysis of raster data semantics in the geospatial domain (CONACyT)
- Geospatial analysis using semantic representations of geographic data (CONACyT)
- Environmental geographic information system for integrated management of urban solid waste in municipalities of Mexico (IPN multidisciplinary project)
- Geographic information system for the analysis of public transport infrastructure in Mexico City (ICyT DF)

Objectives

- Develop mathematical models of problems in various knowledge areas.
- Analyze and simulate mathematical models.
- Apply mathematical models to various phenomena or common problems.

Mathematical Modeling

Modeling is the ability to create an explicit representation of a situation or ideas about a given phenomenon.

It can be expressed through mathematics, symbols or words, but it is essentially a description of entities and relationships between them.

Areas of interest

- Cell automata
- Time series
- Continuous modeling
- High performance and parallel computing

Areas of application

- Vehicular traffic
- Medicine
- Financial markets
- Image processing
- Physics
- Seismology
- Immunotherapy

Simulation

Simulation is a numerical technique for conducting experiments on a computer. These experiments include certain types of mathematical and logical relationships, which are necessary to describe the behavior and structure of complex real-world systems over long periods of time.





Natural Language and Text Processing



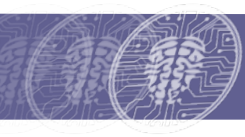
Objective:

for a computer to be able to read,
speak and listen.

To develop computers that can UNDERSTAND our language; LEARN how we learn by reading books, conversing with us; TRANSLATE from one language to another, SEARCH through books better than Google does, SUMMARIZE information; SPEAK without text-generating programs but by means of ANALYZING gigabytes of texts on the web, BE INTELLIGENT and demonstrate it DISCUSSING diverse themes as intelligent people do.



Alisa Zhila, PhD Computer Science student,
2012 Microsoft Research Scholarship Latin
America Award  Microsoft



Intelligent Computer

Research Lines:

- Neural Networks
- Associative Memories
- Pattern Recognition
- Fpga, Micro- and Nanotechnology
- Bioinformatics
- Environment
- Biometrics

ICyTDF - Projects

Project-Piute10-77

A smart sensor for monitoring pollutant emission levels in an automotive vehicle.

Project-Picso10-85

Application of artificial intelligence for predicting pollutants and the metropolitan index of air quality in Mexico City (IMECA).





Intelligent Systems for Automation

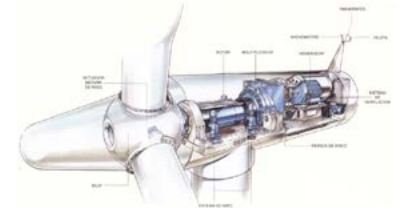


What do we do?

Fundamental research (aimed to achieve advance in knowledge). Short-term and long-term research.

Applied research (research aimed to solve problems or create products and processes in fields of human endeavor in which their application is visualized in near future). Short-term research. It is possible to generate (new) knowledge more linked to application.

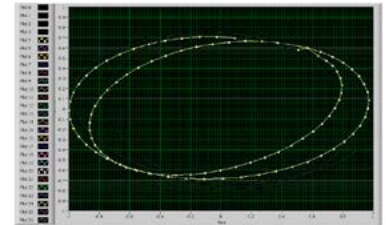
Innovative technological development (research aimed to implement new products and technological processes or to substantially modify existing products or processes in order to improve their efficiency, performance and characteristics in conditions which make possible their immediate transfer to the society).



Análisis de vibraciones mecánicas mediante inteligencia artificial



Análisis orbital de vibraciones mecánicas mediante inteligencia artificial



Areas of interest

- Control and automation
- Measurement and advanced monitoring
- FPGA-based systems
- Real-time systems
- Virtual instrumentation, parallel and distributed programming (in local, industrial networks and Internet)
- Digital signal processing and pattern recognition
- Artificial intelligence
- Modeling and simulation
- Soft sensor
- Mechatronics
- Industrial informatics





Objectives:

Generate new knowledge in the subject area, preparing experts in M.Sc. and Ph.D. programs with solid knowledge along the research lines of the Laboratory, and provide solutions to applied problems. To achieve this, the Laboratory has the necessary equipment, financial resources and devices

The laboratory has collaboration with:

Guadalajara University, León Institute of Technology, Aguascalientes Autonomous University, Center for Research and Advanced Studies of National Polytechnic Institute of Mexico (CINVESTAV-IPN), Ensenada Center for Scientific Research and Higher Education (CICESE), National Autonomous University of Mexico (UNAM), Monterrey Institute of Technology and Higher Education, Complutense University of Madrid, University of Jena, Germany, Free University of Berlin.

Some themes for new M.S.C theses

1. Automated generation of new families of invariant features using evolutionary computation.
2. Form segmentation by means of neural and evolutionary computation.
3. Control of a humanoid robot using a virtual pro header.
4. Control of a humanoid robot using a brain signal headset.
5. Synchronizing two nonlinear systems modeled with fuzzy techniques.
6. State feedback control for an unstable nonlinear system.
7. Modeling, simulation and analysis of a mechanical micro-system.
8. Stability analysis of a discrete system modeled with fuzzy Petri nets.

Current research projects:

Financed by CONACyT and IPN.

Research lines:

Automatic control
Linear, nonlinear and discrete system modeling
System dynamic simulation and analysis
Computer vision
Image analysis
Pattern recognition
Mobile and air humanoid robot control
Control by fuzzy techniques and FPGAS



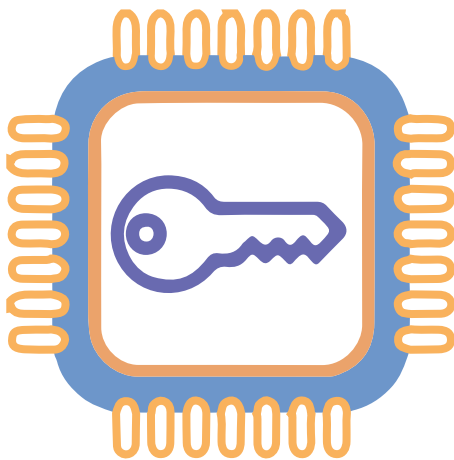


About us **The Laboratory of Cybersecurity (CISEG)** at the Computing Research Center, National Polytechnic Institute (CIC-IPN), arises as a institutional effort to contribute to the search of innovative solutions to address the problem of secure the cyberspace and its users, by s the research on security of information and critical assets of Information and Communications Technologies (ICT).

The creation of CISEG at CIC-IPN is an effort to opportunely align human resources and institutional assets in order to promote research and education on Cybersecurity with the objective to contribute to knowledge and technology generation, as well as educating high specialized professionals on the field. The main topics to be covered by CISEG are:

Infrastructure Security

- Security on Operating Systems and Protocols
- Computer Incident Information Recovery: Forensics
- New Architectures for Intrusion Detection Systems
- Malware detection and propagation and Advanced Persistent Threats (APT)
- Security in the Internet of Things
- Security on Critical Infrastructure Monitoring Technologies
- Analysis and Design of Security Protocols
- Cryptographic Implementations>/
- Cryptanalysis
- Application of Evolutionary Algorithms for Cybersecurity
- Biometrics



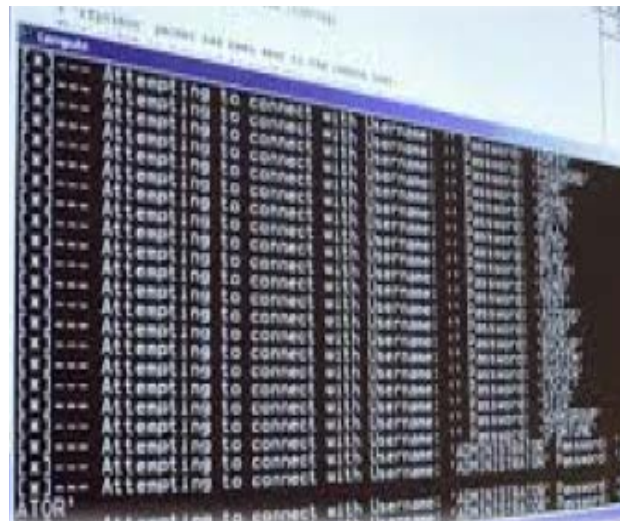
Research Topics

Security in Cyberspace

- > Safety Data Networks and the Internet
- > Host Security
- > Network Forensics
- > Host Forensics
- > Evaluation of the safety of infrastructure

IoT Security

- > Mobile Devices
- > Wireless Sensor Networks
- > Machine to Machine (M2M)
- > Supervisory Control and Data acquisition (SCADA)
- > RFID and NFC





Research Topics

Cryptography

- > Side channel attacks.
- > Cryptanalysis.
- > Elliptic Curve Cryptography
- > Cryptographic Implementations
- > Electronic payments.
- > Electronic voting.
- > Cryptography for Cloud Services and Big Data.



Evolutionary Algorithms for Cybersecurity

Biometric Security

- > Construction of biometric systems
- > Biometric Authentication
- > Access Controls





Complementary activities

In the IPN, the practice of complementary activities is a strategy to reach integrated education considered as a combination of:

Sports

IPN has modern facilities for daily practice of sports such as swimming, cycling, tennis, soccer, baseball, football, basketball, track and athletic practices, Taekwondo, Judo, wrestling, etc.

Recreation

On the IPN campus of Zacatenco, the facilities include large green areas, sculptural spaces, outdoor areas and a bell chime musical park.

Culture

For all artistic expressions there is a space on the campus of Zacatenco where the IPN promotes theater, dance, music, film art, folk art, among others.

The seasons of the IPN Symphony Orchestra and the performances of choral Alfa Nova are examples of this activity promoted by the IPN to general public.

Entertainment and Dissemination of Science and Technology

IPN includes the Luis Enrique Erro Planetarium building and the Constellations area, modern infrastructure created to raise awareness of space science and their importance in our lives.

These programs are offered to all polytechnic students to supplement their education through such activities as training, technical updating and professional management training, continuing education and foreign language teaching.

Entrepreneurship Culture

IPN promotes a direct linkage with the productive sectors as part of its institutional strength by including youth entrepreneurship training. Business program PoliEmprende has become the bridge that links learning with practical application, encouraging creativity, initiative, and ability to work and take risks. Economic independence of students is encouraged by supporting students to carry out the incubation process of their own business.

- In 2010, 213 graduates are reported in the Engineering Entrepreneurship Program, in collaboration with INSA-Lyon (France) and the Polytechnic Foundation support.

- The Institutional Program for Entrepreneurs (PoliEmprende) involves students in entrepreneurial projects for the start-ups. The program supported 1,048 projects involving 2,931 students during the 2012 academic year.

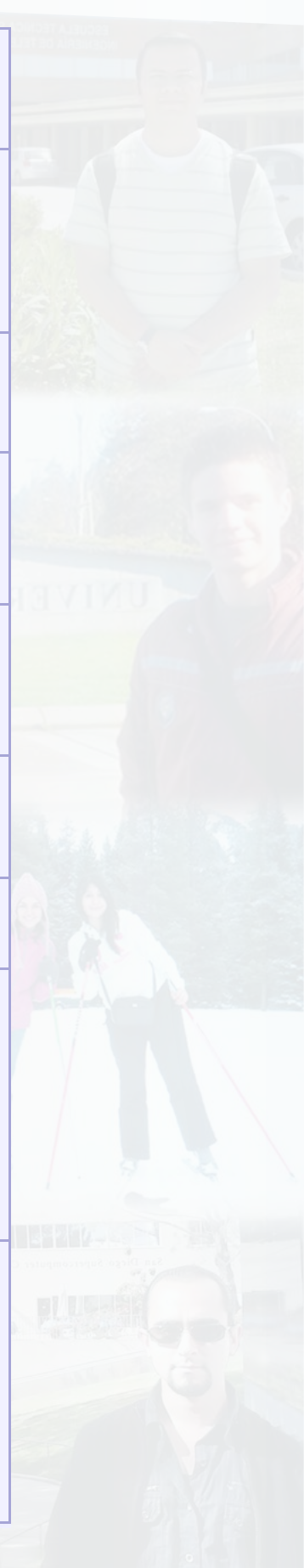
Services and technological solutions

- 45 companies were incubated, generating a total of 200 jobs.

- 331 Institutional agreements were negotiated increasing the technological relationship that allowed a flow of revenue of more than 76.3 million USD during 2012.

IPN - Collaboration with other Academic and Research institutions

Brazil	Universidade do Sao Paulo UNICAMP Universidade Estadual de Campinas
Canada	University of Alberta University of British Columbia École Polytechnique de Montréal New Brunswick University
Chile	Pontificia Universidad Católica de Chile Universidad de Los Lagos de la República de Chile
France	Université Joseph Fourier à Grenoble, Institut Aéronautique et Spatial. MINATEC
Germany	Freie University of Berlin University of Stuttgart, University of Applied Science Cologne
Portugal	Universidade do Porto Instituto Superior Técnico/Universidade Técnica de Lisboa.
Russia	Lomonosov University in Moscow
Spain	Universidad Politécnica de Cataluña UPC Universidad Complutense de Madrid Barcelona Supercomputing Center BSC Universidad de Cantabria Universidad Politécnica de Madrid UPM Instituto de Investigación Tecnológica IIT-UPC de Madrid Universidad de Málaga
United States of America	Oklahoma State University San Diego Supercomputer Center, University of California (Irvine, Sta. Cruz, Berkeley) New Mexico State University. Massachusetts Institute of Technology Texas A&M University University of Texas at Dallas LASPAU - Harvard University



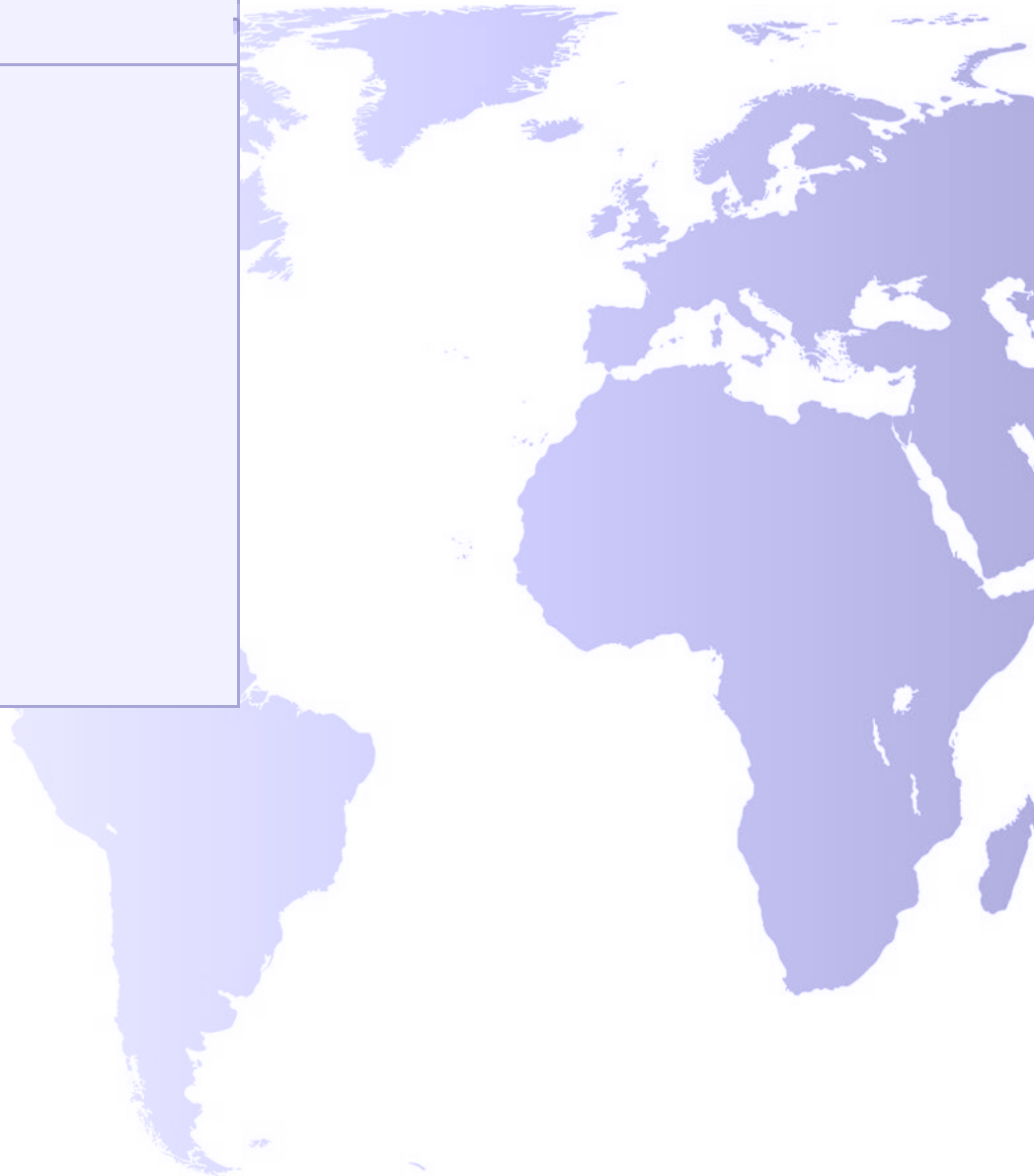
IPN Collaboration with other institutions

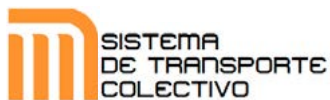


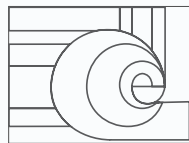
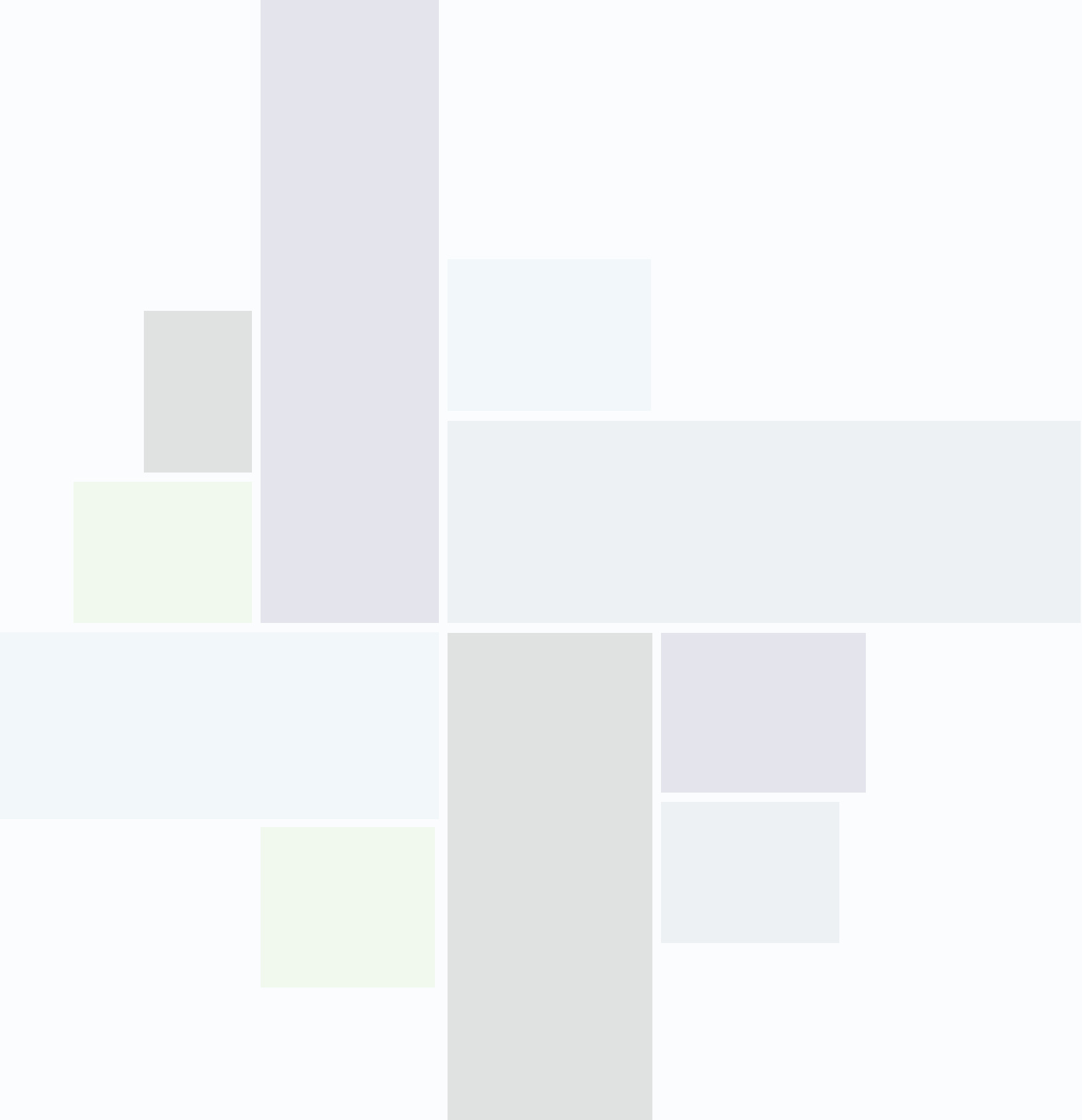
CIC International Cooperation

Business enterprise relationships:

Foreign	Intel (Internship Program at Intel Guadalajara) Microsoft BOSCH LACCIR SANDIA MOSIS ORACLE MINATEC LG
National	PEMEX IMP STC - METRO SEMAR SSP SEDENA IFE IEDF SEGOB RENAPO SAT







Centro de Investigación
en Computación
Instituto Politécnico Nacional

Computing Research Center CIC-IPN
Website <http://www.cic.ipn.mx>
Telephone +52 (55) 5729 6000, Ext. 56506