**Haute école d'ingénierie et d'architecture Fribourg**
Hochschule für Technik und Architektur Freiburg

**INSTITUTE OF COMPLEX SYSTEMS**

# iCoSys

Building complex engineering systems
for complex societies

iCoSys

Institute of Complex Systems

# iCoSys : Institute of complex systems

A system is classed as complex when it is made up of a large number of interacting subsystems and when it is difficult to establish simple rules explaining the behavior or development of the system. The Institute of Complex Systems defines its scope in this emerging domain in which informatics, intelligent data analysis, massively distributed computing, mathematical modeling and systems of systems are the main supports.

The Institute's vision is thus to foster technological innovation in the field of complex systems to serve sustainable economic development and education. By encouraging knowledge and technology transfer from the academic domain to the local and regional economy, the Institute aims to develop interdisciplinar y approaches and extend its national and international cooperation activities.

## Innovation topic

The institute concentrates on areas with considerable added value for the economy, with activities and concrete projects in a range of fields such as environmental applications, intelligent buildings, energy management, pathology detection, intelligent mobility and event detection in video stream monitoring. The institute specializes in mass information processing, cloud computing, machine learning, business intelligence and signal processing.

## Scientific equipment

- Computers cluster for massively distributed computing
- Parallel computing tools and specialist equipment such as GPU cards
- Scientific libraries for data modeling and intelligent data analysis
- Software and hardware gateways to sensor networks for acquiring data from the field

## Research focus areas

The complex systems field being very broad, the iCoSys Institute focuses on the following areas:

- **Distributed Computing**
  parallel and large-scale distributed systems, middleware for programming and monitoring systems, mobile systems
- **Intelligent Data Analysis**
  machine learning, big data analysis, signal processing, algorithms
- **Sustainable ICT for Smart Living**
  data management and processing for sensor networks, Web of Things, energy efficient IT, IT for efficiency approaches.
- **ICT for Industry 4.0**
  smart solutions including anomaly detection, simulation, quality assessment and prediction and predictive maintenance.

## Research team

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|---|---|
| Co-directors: | 2 |
| Professors: | 6 |
| Staff: | 12 |
| PhD students: | 6 |

# Exemples de projets

## SwissTranslation - Translation of Swiss German to High German

Nowadays, Swiss German speakers have to switch to another language, such as High German, French, Italian, or English, if they want to profit from automatic translation or speech recognition services. Swiss German is mostly a spoken language, only rarely appears in writing, has a large number of different dialects, and no standardized orthography. Hence it is not surprising that the current state of the art in natural language processing fails for this challenging case. In collaboration with Swisscom, the Institute of Complex Systems tackles this challenge. Leveraging recent breakthroughs in weakly supervised deep learning technologies, the project aims to develop novel methods for automatic translation from Swiss German to High German that are able to cope with a lack of large text corpora.

## Sensimed Diagnosis CTI project – from sensor to understanding

The Triggerfish® sensor developed by the Lausanne company SENSIMED continually measures distortions linked to intraocular pressure. The CTI project SENSIMED Diagnosis is the result of cooperation between iCoSys, SENSIMED SA and the Sierre Business Information Systems Institute. It aims to take the data measured by the Triggerfish sensor and to provide signal processing and machine learning algorithms to help in glaucoma diagnosis. Glaucoma is a serious illness which can lead to blindness and afflicts more than 80 million people in the world, and the SENSIMED Diagnosis project is able to take the modeling characteristics of thousands of healthy patients and those with glaucoma in order to give a reliable prediction for new patients. In this project, iCoSys has contributed to  the development of signal processing modules and has provided machine learning algorithms integrated into the software which will be marketed among ophthalmology specialists.
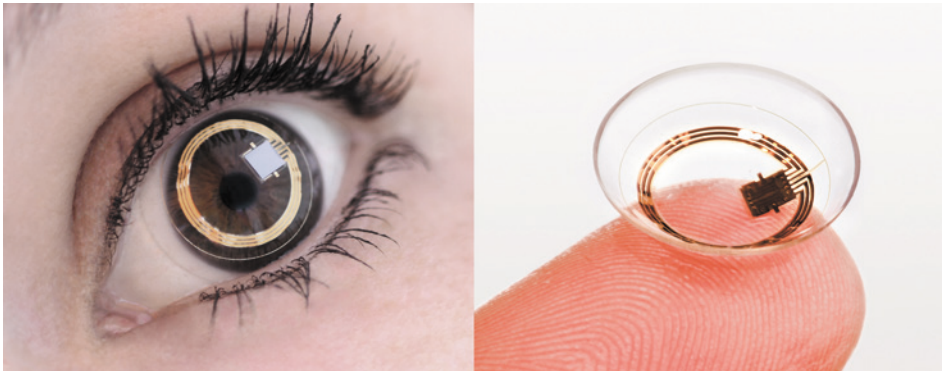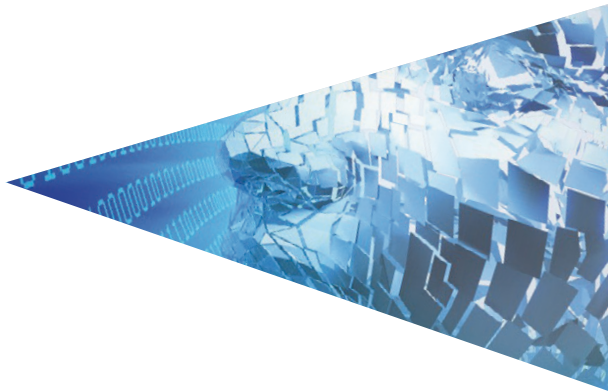
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