Génie Electrique et Electronique
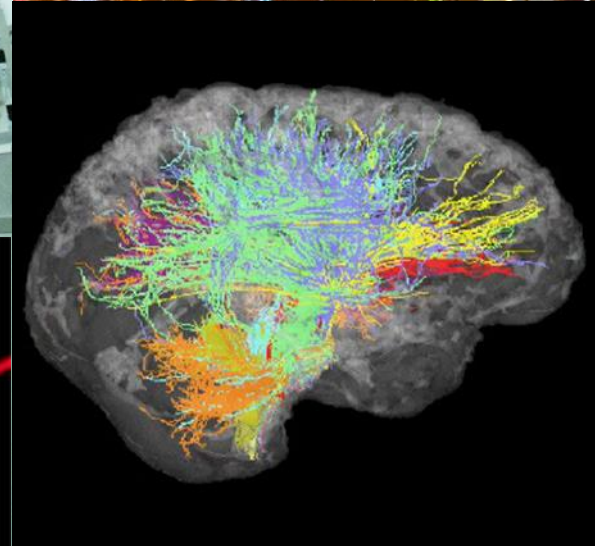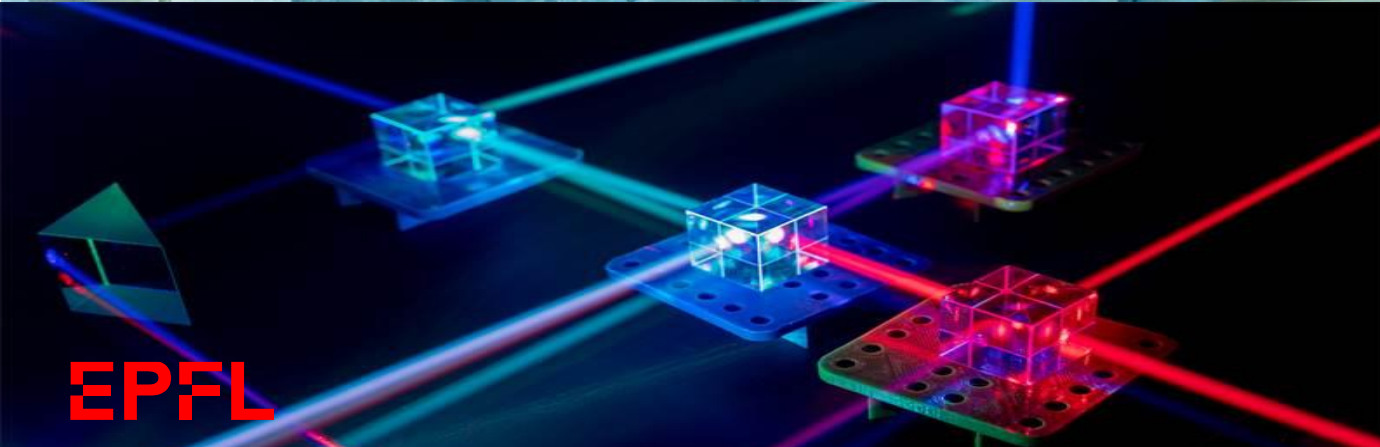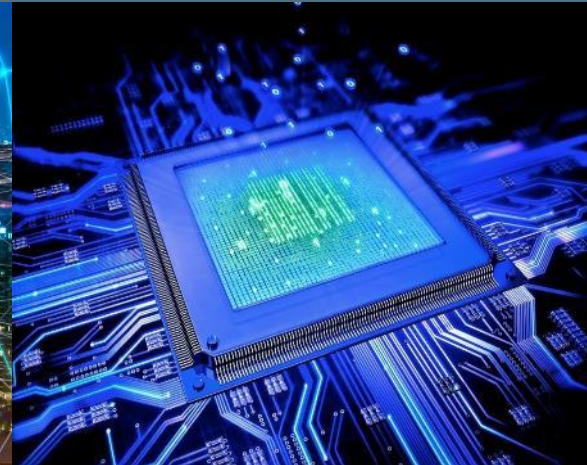
SEL Study Project Information (Fall 2022)

Information on Semester Projects and List of Projects

https://sti.epfl.ch/research/institutes/iem/master-and-semester-projects-sel/

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SEL

Steps to Register for a Semester Project

1. Find a master/semester project
   - Visit the web pages of the IEM laboratories using the links given on the first page
   - Verify that the Professor in charge of the project is affiliated with SEL
   - For projects with other sections, submit your project to SEL for approval

2. Contact the Professor **or PhD student** in charge of the project
   - Discuss your project with the Professor or the associated PhD student
   - Agree on your project with the Professor

3. Registration with IS-Academia
   - Register with IS-Academia (only the registration with IS-Academia is authoritative)
   - Save and print your registration

EPFL   SEL

General Remarks

- Study projects can be carried out as
  - BSc Semester projects (BA6: Projet d'électricité): 7ECTS
  - MSc Semester project (MA2/3: Project in EE): 10 ECTS

- Projects start at the beginning of the semester

- You are responsible to
  - Register with the SAC
  - Approach your advisor shortly before the start of the semester or latest in the first week of the semester to arrange for a kick-off meeting
  - Approach your advisor early in the project in case of issues

- Semester project reports should be handed in before the start of the exam session, BUT extensions can be discussed with your advisor

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# Electromagnetic Compatibility Laboratory (EMC)

- **Lightning discharge**
  - Modeling, experimental characterization, protection and nowcasting

- **Time Reversal**
  - Application to fault location in power networks, humanitarian demining and partial discharge localization

https://www.epfl.ch/labs/emc/education/projects/
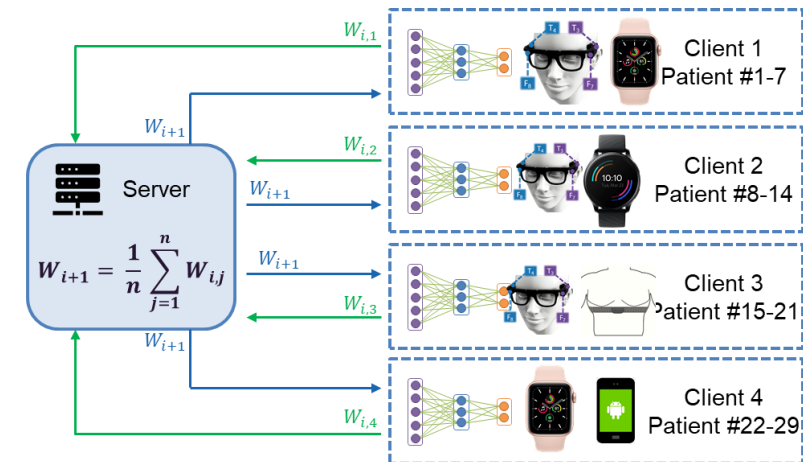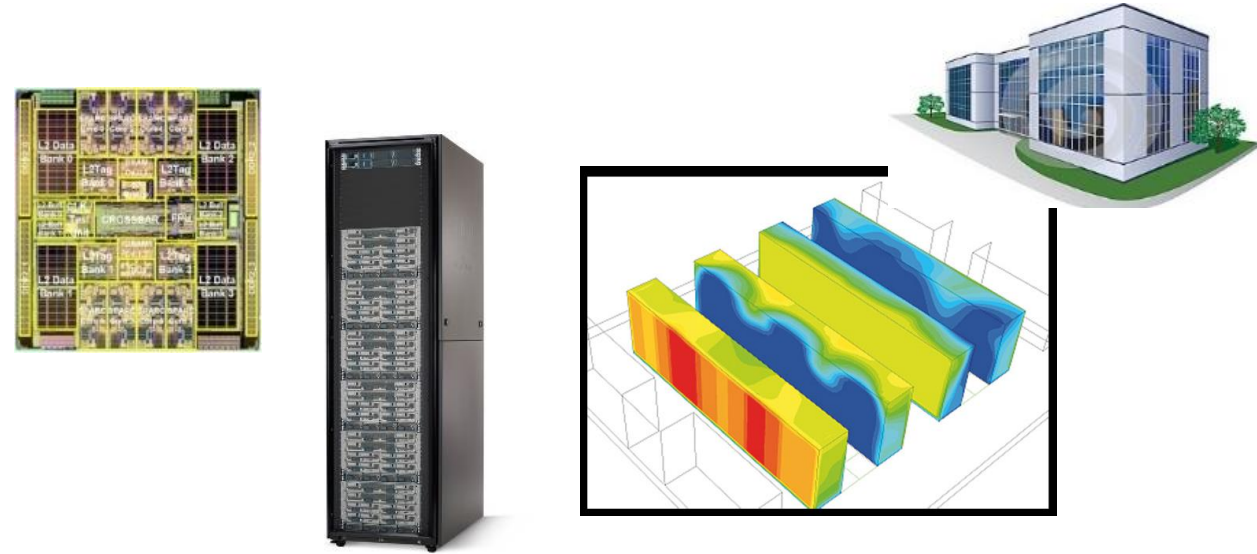
Embedded Systems Laboratory (ESL)

- **Smart embedded systems and Edge AI architectures**

  - Design of wearable systems (hardware and embedded software design)

  - Architectures of accelerators for embedded systems and FPGAs

  - Embedded machine learning (ML)

- **Internet of Things (IoT) systems**

  - Low-power multi-processor architectures for ML inference and training

  - HEEPocrates: open-source healthcare energy-efficient platform – IC Design

  - Medical wearables devices

https://www.epfl.ch/labs/esl/studentprojects/
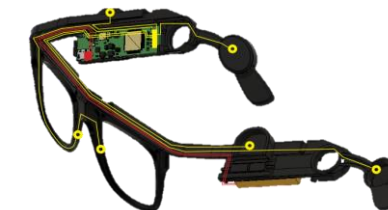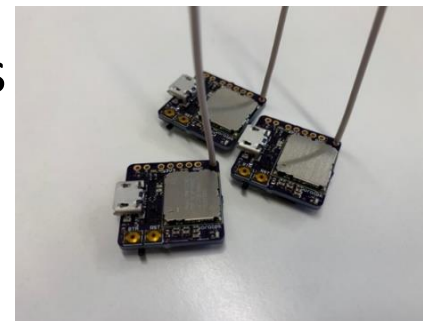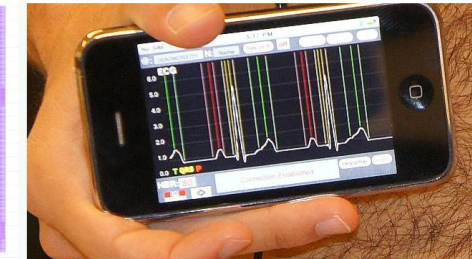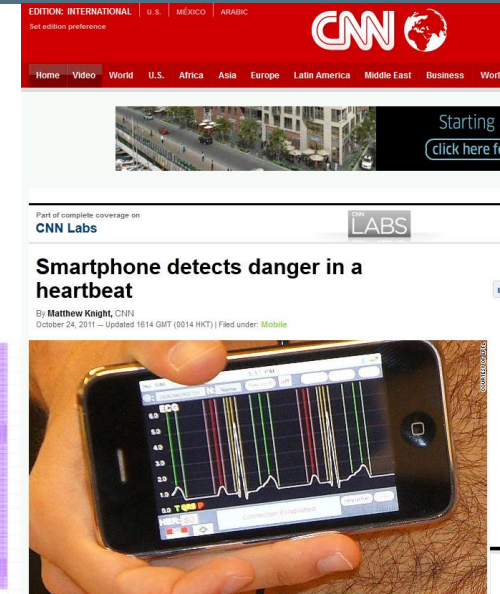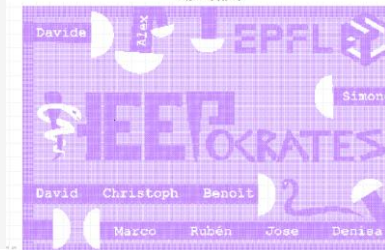
Embedded Systems Laboratory (ESL)

- **Sustainable cloud computing**

  - Cooling-aware design of many-core servers and racks

  - Data center scheduling algorithms with renewables energy sources

  - Embedded machine learning

- **Sustainable Deep Learning (DL) and Machine Learning**

  - Federated and distributed machine learning optimization

  - Low-power architectures for DL training

  - Digital Twin technologies for sustainable cities and urban environments

https://www.epfl.ch/labs/esl/studentprojects/

Integrated Neurotechnologies Lab (INL)

- **Neural Interface IC Design**
  - Neural **recording** circuits
  - **On-chip machine learning**
  - Real-time **symptom tracking**
  - **Neurostimulation**
- **ML Algorithm Design for Neuro Applications**
- Efficient **On-chip Processing, Biomarker** Extraction

https://www.epfl.ch/labs/inl/inl/student-projects/

Integrated Neurotechnologies Lab (INL)

- **Low-Power Mixed-Signal IC Design for Sensor Interfaces**
  - Neural implants for **psychiatric disorders**
  - **Adaptive stimulation** for Parkinson's disease, epilepsy
  - **Brain-Machine Interfaces**
- **Energy-Efficient ML Processors**
- Compressive Sensing

https://www.epfl.ch/labs/inl/inl/student-projects/

Signal Processing Laboratory 2 (LTS2)

- **AI/ML for graph-based data and geometric deep learning:**
  - Biology: protein design, modeling of cellular processes
  - Analysis of omics data
  - Neuroscience
  - Sensors
  - …

https://lts2.epfl.ch/projects/list
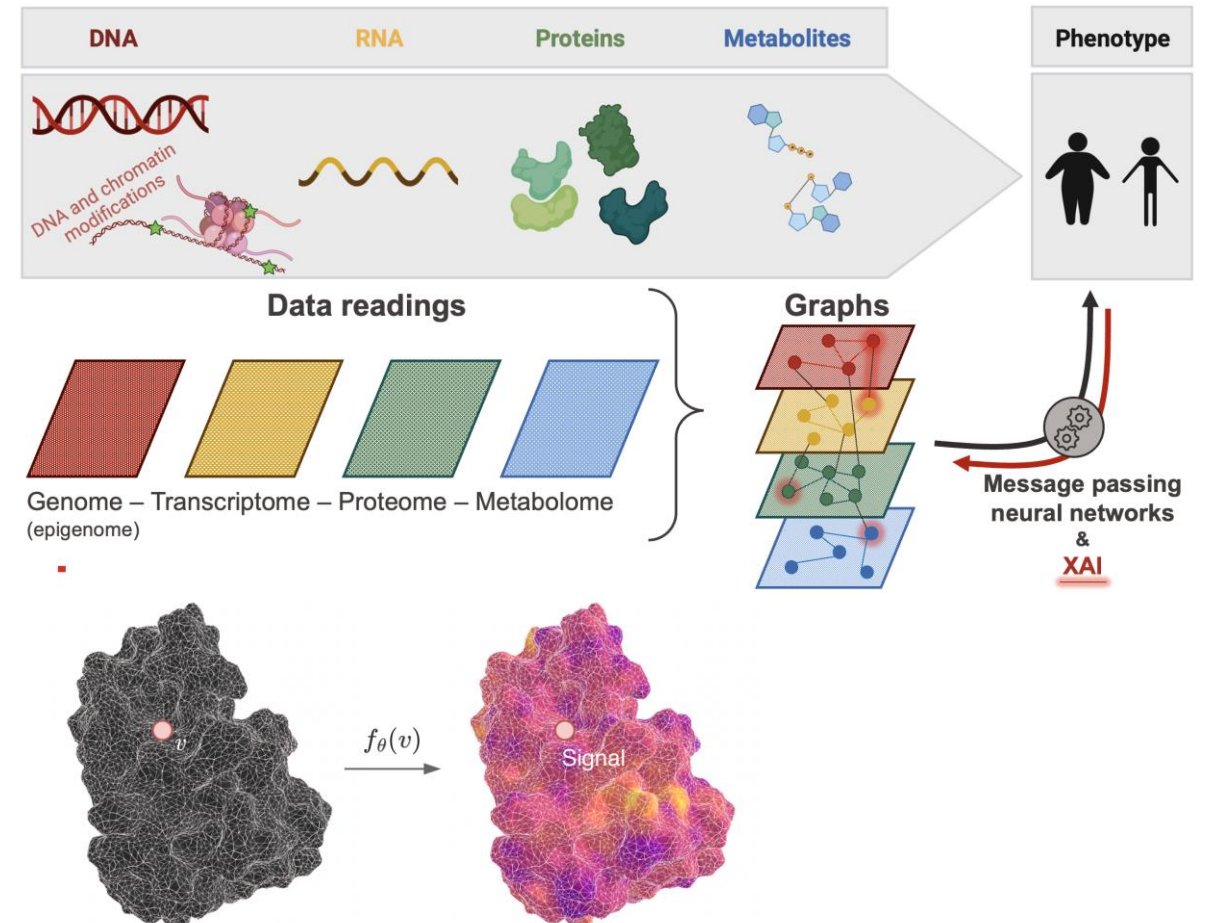
Signal Processing Laboratory (LTS4)

- Machine learning
  - Robust machine learning
  - Interpretable models and algorithms
  - Network analysis
  - AI for medicine

- Signal and image processing
  - Graph signal processing
  - Image representation and communication
  - Distributed signal processing

This is an Indian elephant
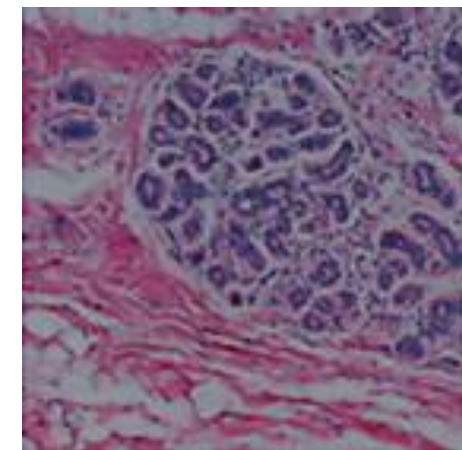
Digital Pathology

Brain Networks

Prof. Pascal Frossard

http://lts4.epfl.ch
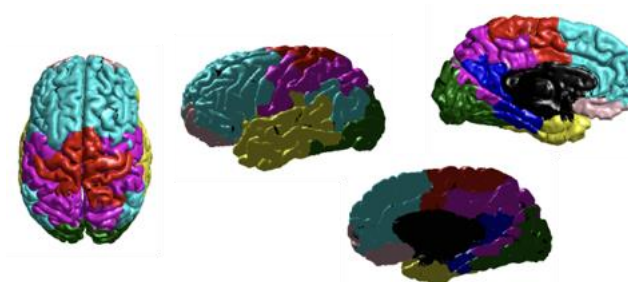
Signal Processing Lab 5 (LTS5)

- **Computational medical imaging:**
  - Magnetic Resonance, ultrasound imaging and digital pathology (microscopy)
  - Image reconstruction and analysis
  - Via inverse problems & Machine Learning
  - In brain imaging and in oncology
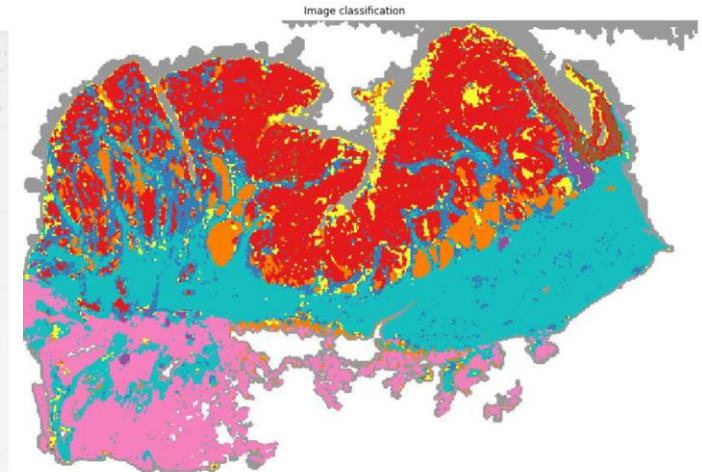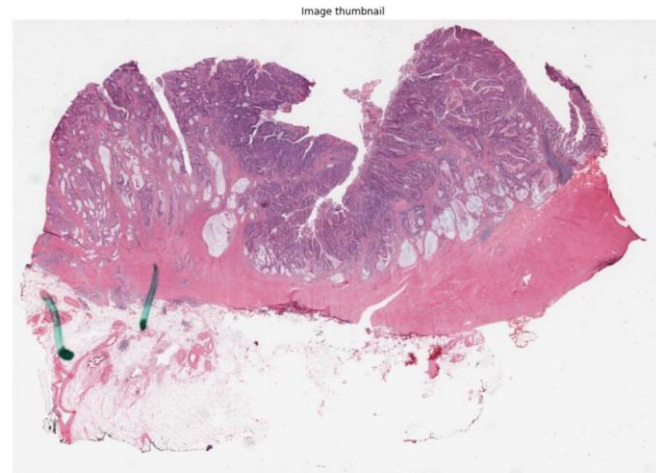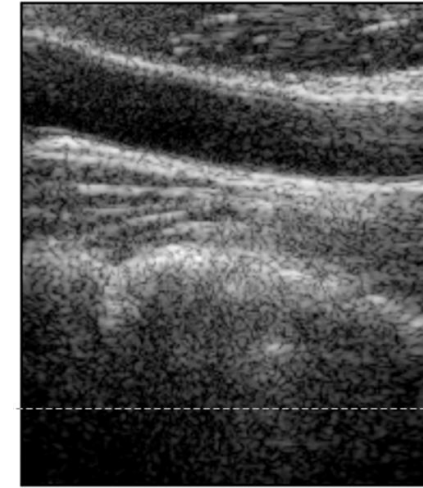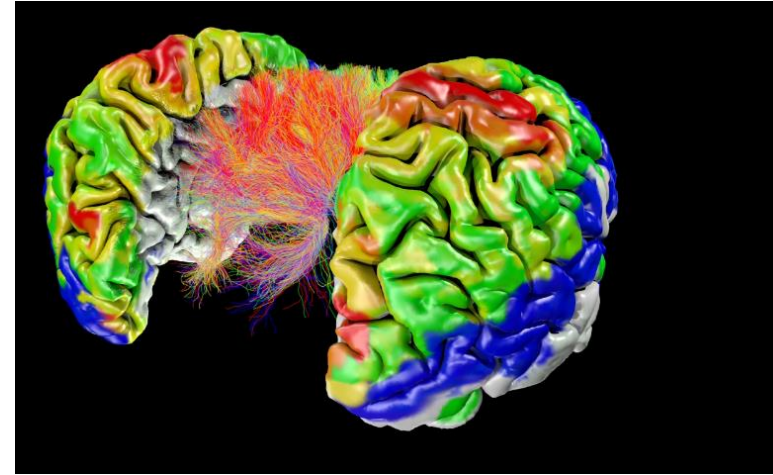
https://www.epfl.ch/labs/lts5/student_projects-html/

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SEL

- **Computer Vision:**
  - Image modality conversion
  - Anomaly detection
  - Object detection, recognition and tracking
  - With Machine Learning (self-supervised learning)
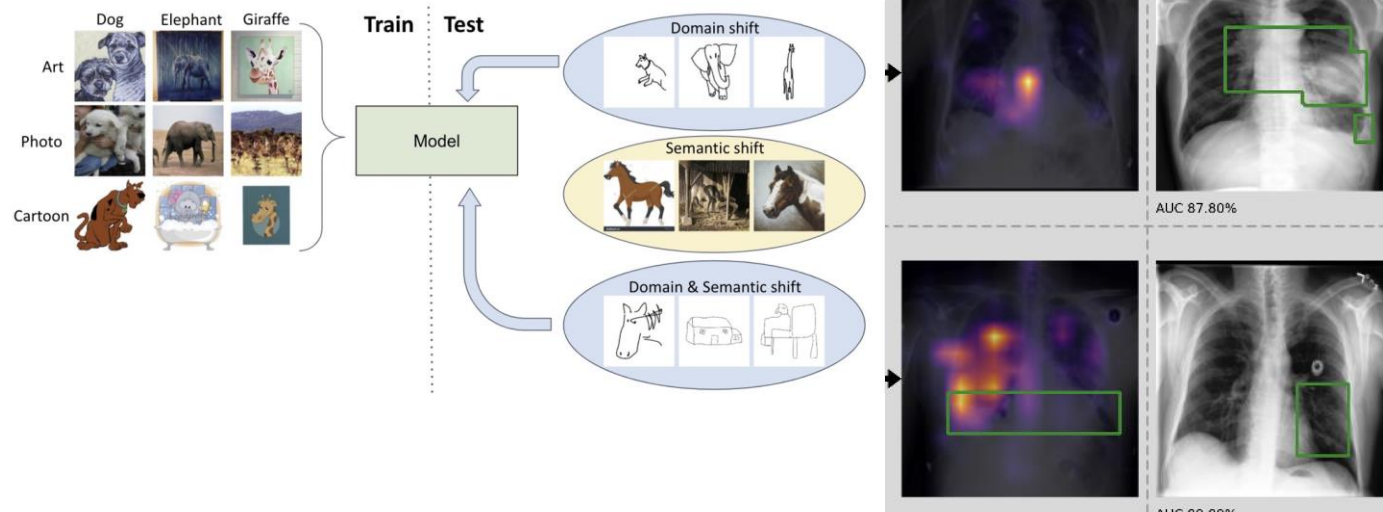
https://www.epfl.ch/labs/lts5/student_projects-html/

# Microwaves and Antennas (MAG) – Prof. Skrivervik

- **Antennas**
  - Antennas for medical implants
  - Wireless propagation in biological tissues
  - Antennas for CubeSats
- **Microwaves**
  - Microwave resonators for atomic clocks
  - Design of an Amplifier in the Ka Band
- **EPFL Make projects**
  - Antennas for MAKE projects
  - Mirowave components for make projects
- **Customized projects on demand**

https://www.epfl.ch/labs/mag/page-141487-en-html/page-141766-en-html/
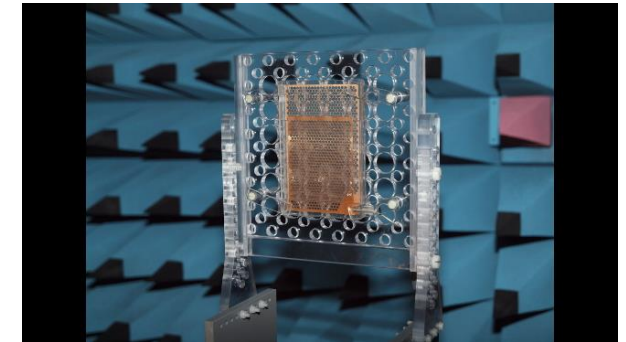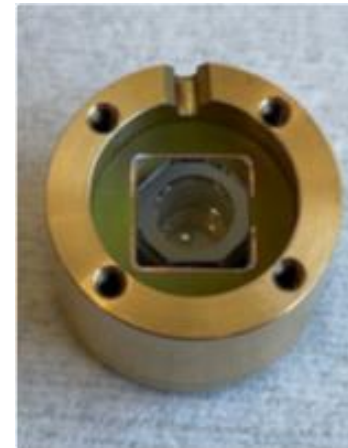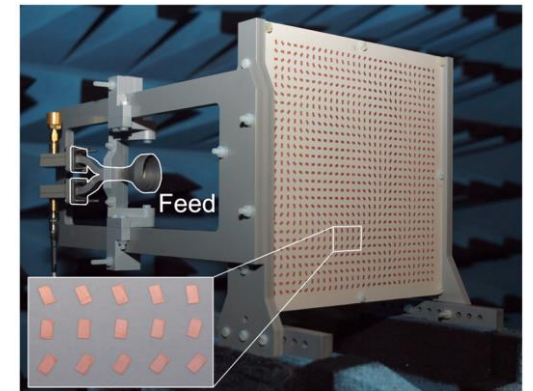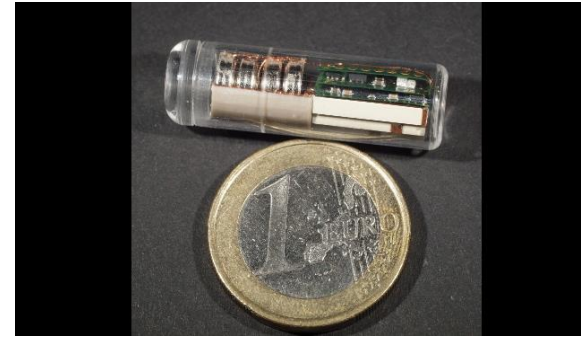
# Mixed-Signal Integrated Circuits Lab (MSIC Lab)

- **Analog/Mixed Signal ICs**
  – with SPICE and Cadence

  - Compact mixed-signal circuits
    - Circuits for in-memory computing
    - Circuits for high-speed communication interface

- **AMS system on PCB**
  – with Altium, Python and lab work

  - Infraboard ecosystem
    - Digitally controlled references
    - pW power measurement

https://www.epfl.ch/labs/msic-lab/master-semester-intership-projects/
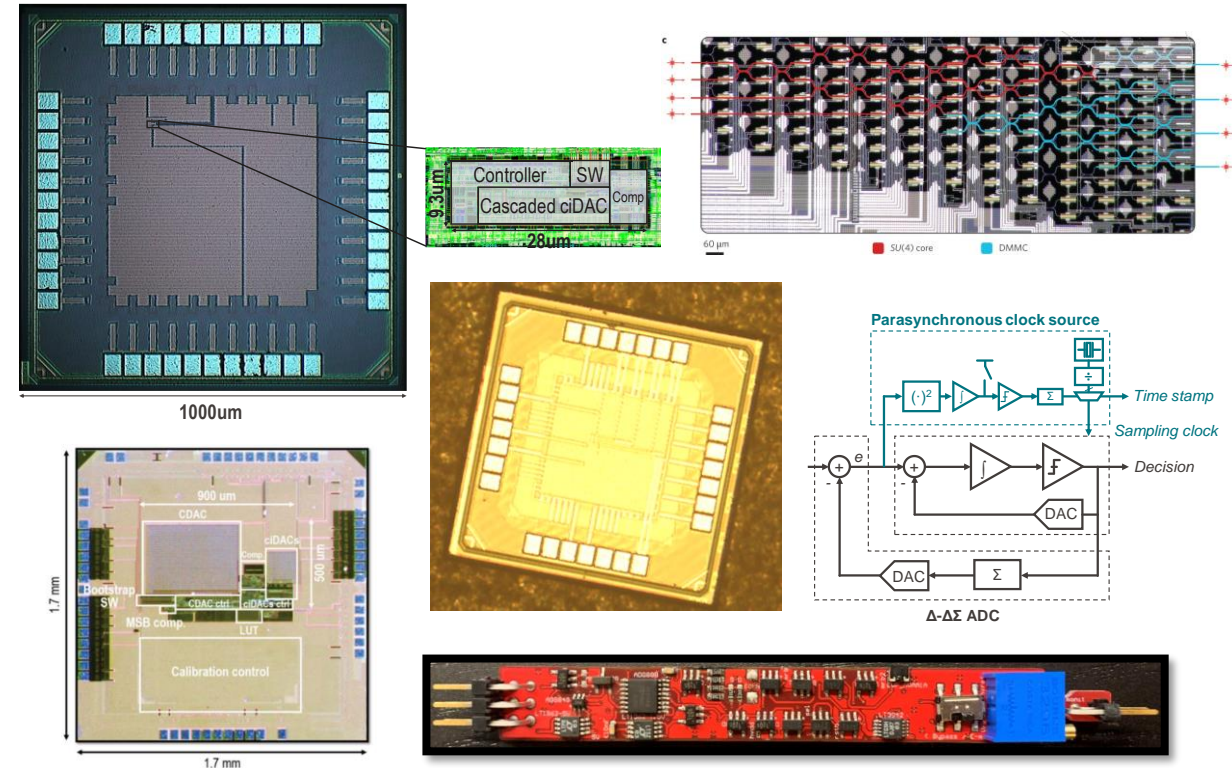
# Mixed-Signal Integrated Circuits Lab (MSIC Lab)

- **Ultra-Low-Power Systems**
  - **– with Circuit / FPGA / PCB / Lab work / C+Linux**

  - Circuits: Ultra-low-power sensor/actuator interface circuits

  - FPGA: PC to various peripheral interface translation

  - System + PCB: Modular ULP component integration and programming

https://www.epfl.ch/labs/msic-lab/master-semester-intership-projects/
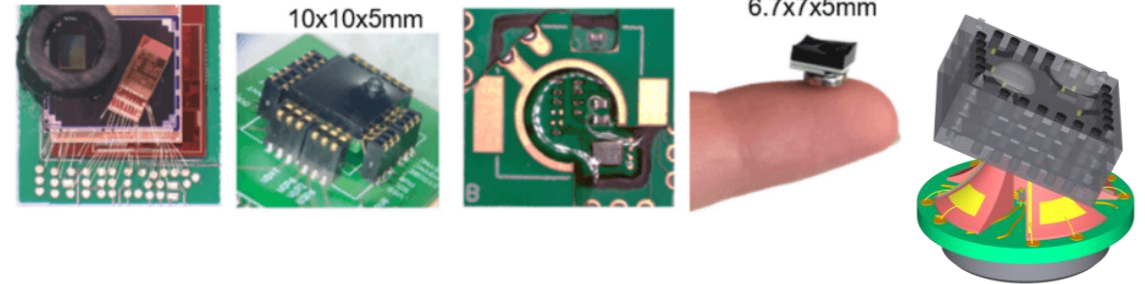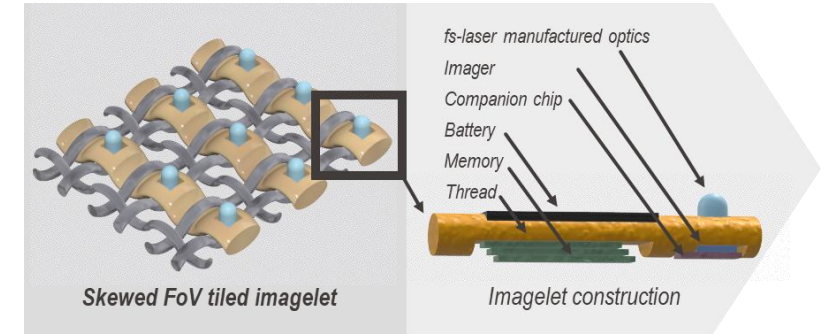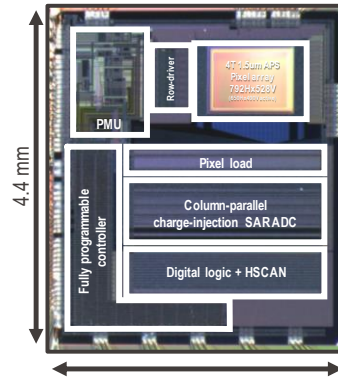
# Power Electronics Laboratory (PEL)

- Power Electronics Conversion

- Modeling

- Simulations
  - Offline (MATLAB, PLECS)
  - Real-Time HIL
  - FEM, CFD
- Design optimization
- Digital control (TI DSP)

https://www.epfl.ch/labs/pel/student-projects-2/
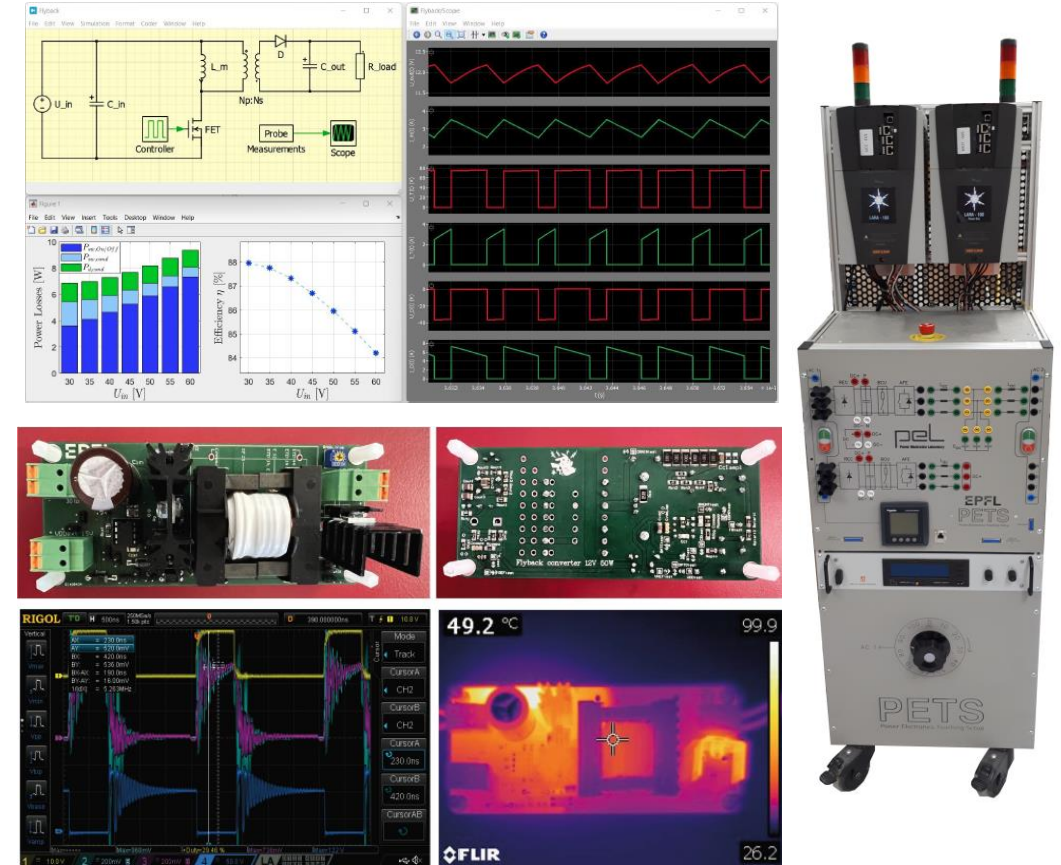
# Power Electronics Laboratory (PEL)

- **Power Electronics Converters**
  - Design optimization
  - Power semiconductors
  - Magnetic devices
  - Thermal management
  - Integration
  - Prototyping
  - Experimental validation

https://www.epfl.ch/labs/pel/student-projects-2/
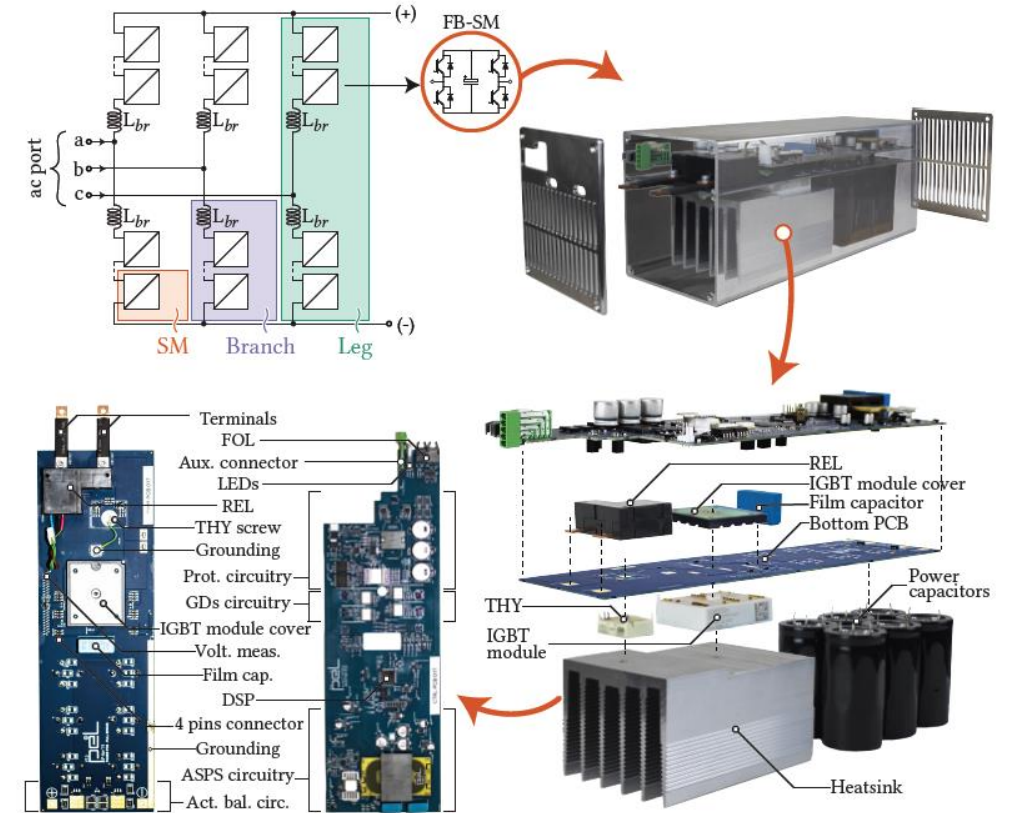
Photonic Systems Laboratory (PHOSL)

- **Integrated linear and nonlinear photonic**
  - Desin and simulations of optical waveguides and microresonators - comsol, lumerical, matlab
  - Experimental characterization of integrated optical devices– coupling, losses, dispersion, quality factor etc
  - Experimental characterization of nonlinear behavior – high power behavior

https://www.epfl.ch/labs/phosl/teaching/
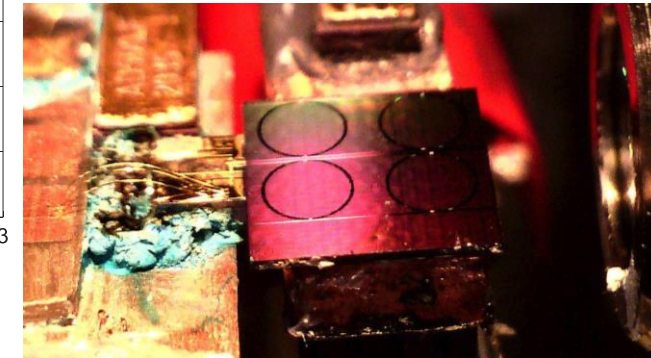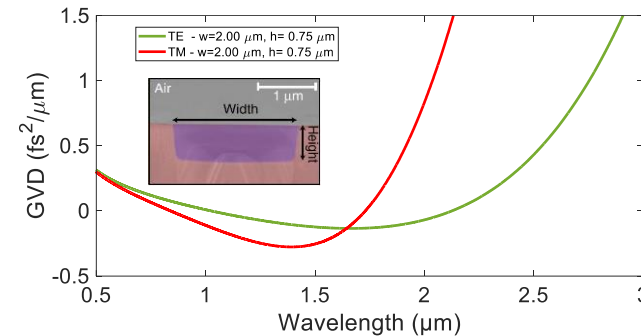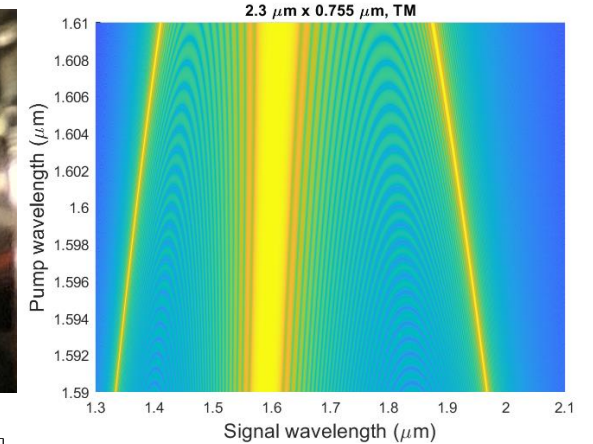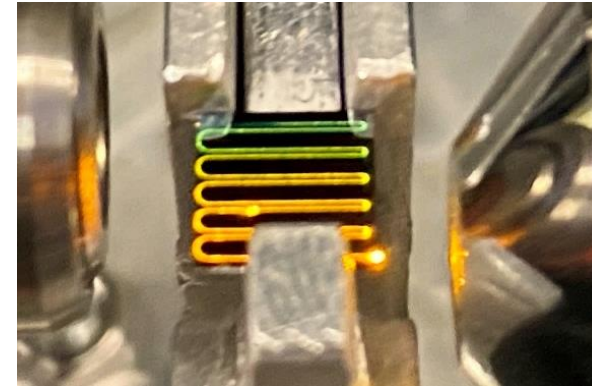
Photonic Systems Laboratory (PHOSL)

- **Light generation in waveguides**
  - Specialty optical fibers
  - Fiber laser architectures
  - Nonlinear frequency conversion
  - Supercontinuum generation

- **Light manipulation**
  - Modulation of light by electro optic effect
  - Light shaping in and outside optical cavities

https://www.epfl.ch/labs/phosl/teaching/
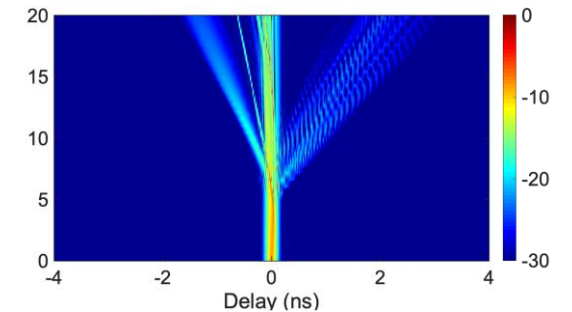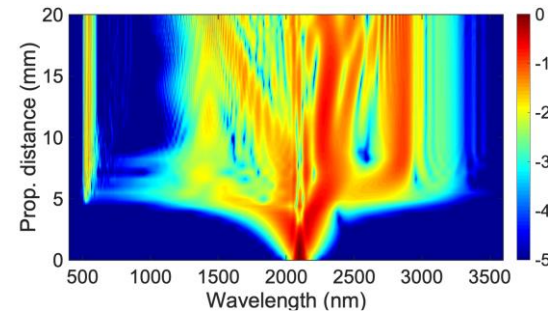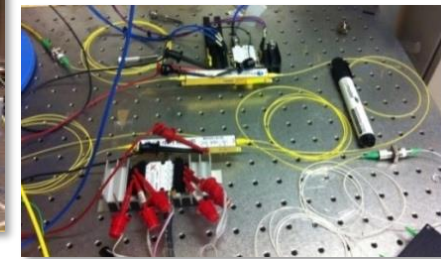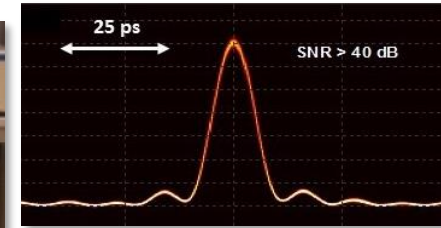
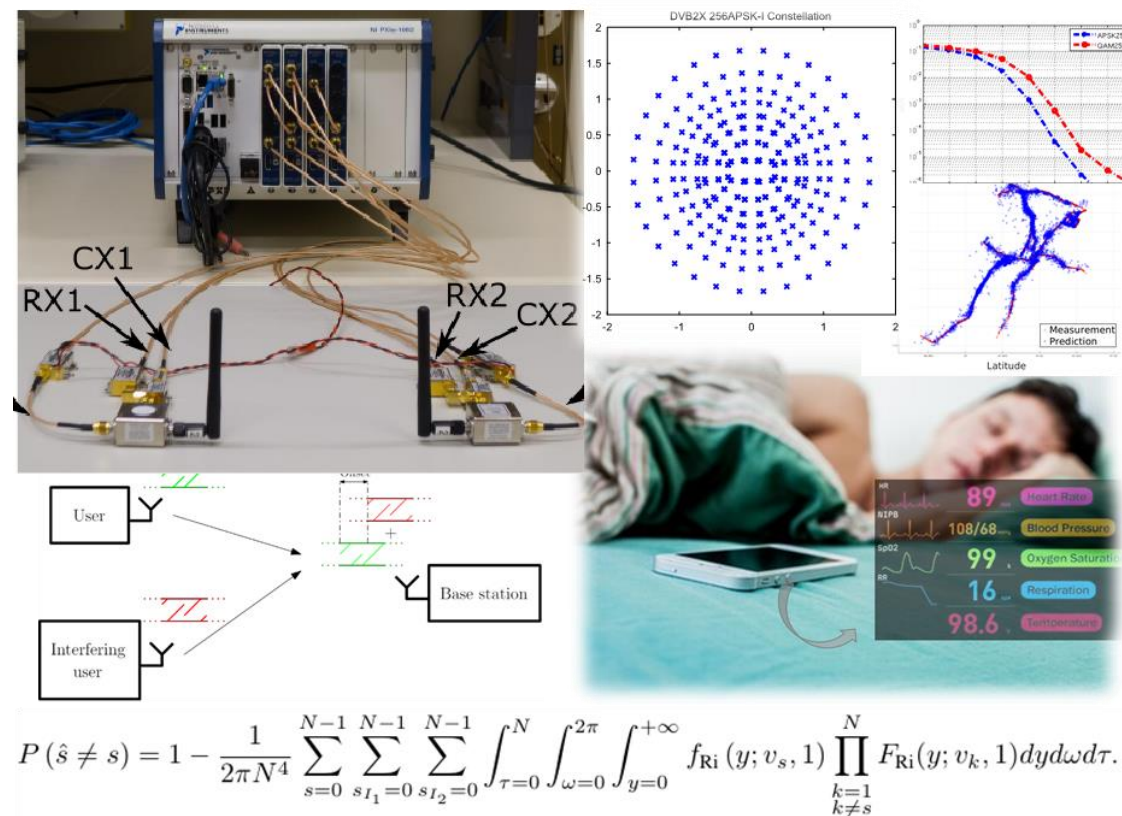# Telecommunications Circuits Lab (TCL)

- **FPGA Design** in VHDL/Verilog

- **Digital integrated circuits**

- Design in VHDL/Verilog
  - Architectures for DSP
  - Computer/SoC architectures

- Full Custom Digital Design
  - Embedded memories
  - Low-power logic design

https://www.epfl.ch/labs/tcl/page-87315-en-html/
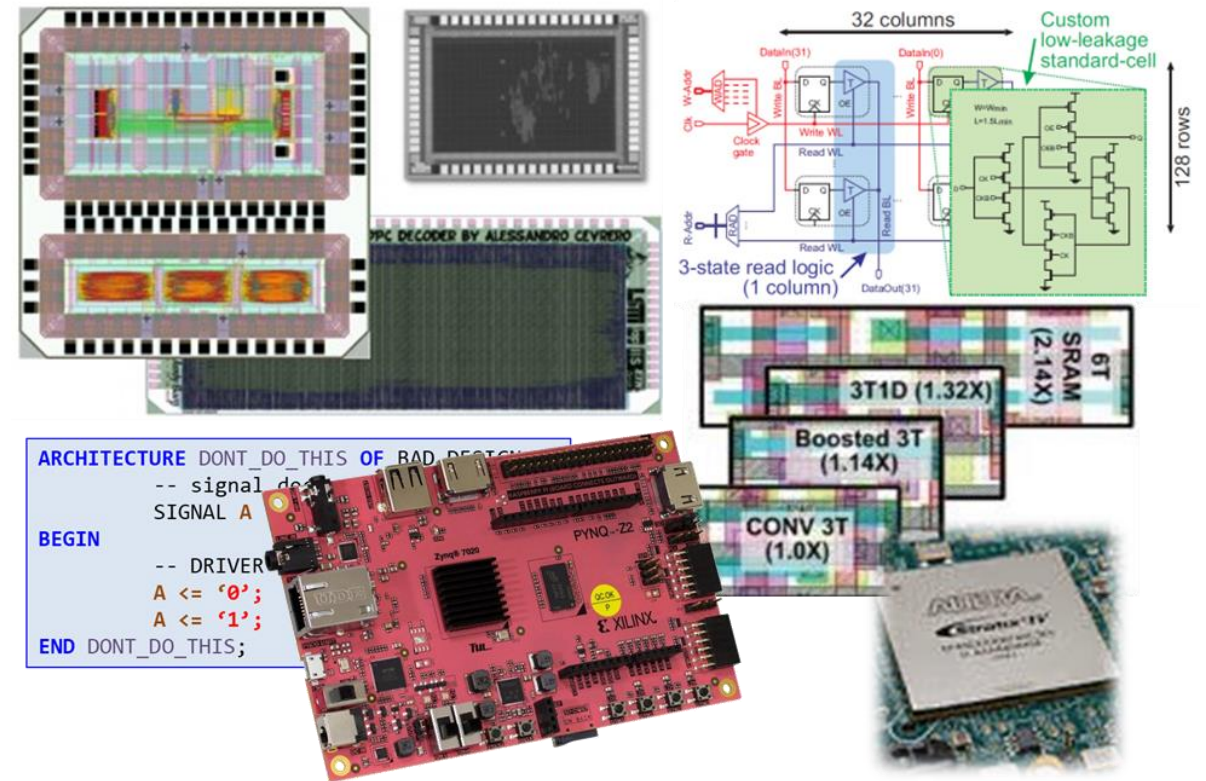
Telecommunications Circuits Lab (TCL)

- **Communication systems**
  - High-performance and low-power communications
  - System design & optimization
  - Receiver algorithms
  - Prototyping & experiments
- **Wireless sensing with ML/AI**
  - Localization, environmental & vital signs sensing

$$P\left(\hat{s} \neq s\right) = 1 - \frac{1}{2\pi N^4} \sum_{s=0}^{N-1} \sum_{s_{I_1}=0}^{N-1} \sum_{s_{I_2}=0}^{N-1} \int_{\tau=0}^{N} \int_{\omega=0}^{2\pi} \int_{y=0}^{+\infty} f_{\mathrm{Ri}}(y; v_s, 1) \prod_{\substack{k=1 \\ k \neq s}}^{N} F_{\mathrm{Ri}}(y; v_k, 1) dy d\omega d\tau.$$

https://www.epfl.ch/labs/tcl/page-87315-en-html/

Operation of the infrastucture

- Control of vacuum system

- Real time data acquisition

- Sensors integration

Pod Design and optimisation

- Battery design

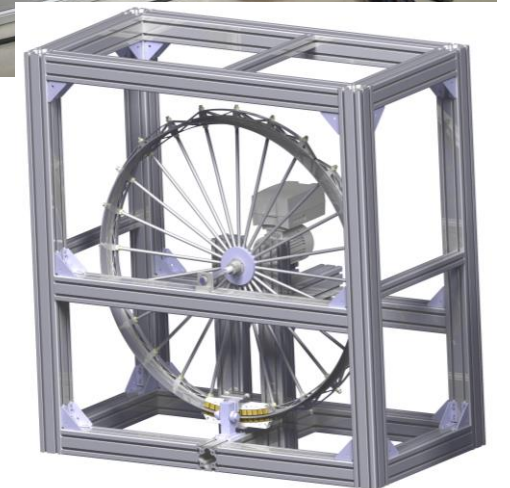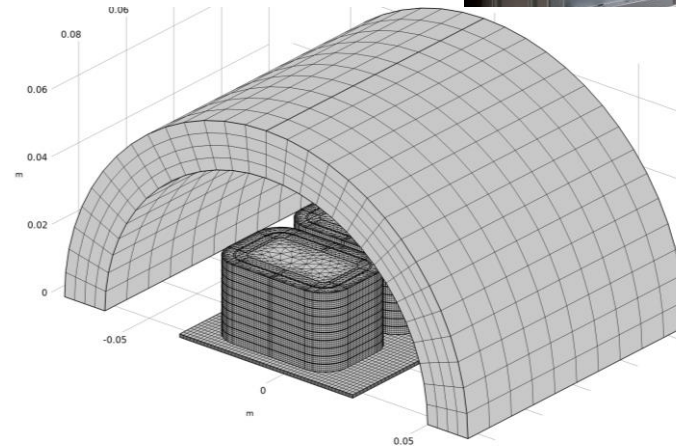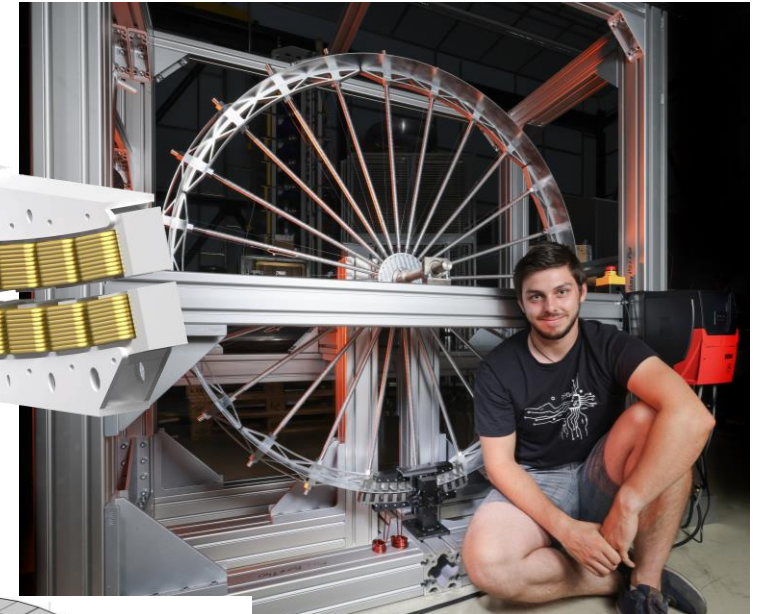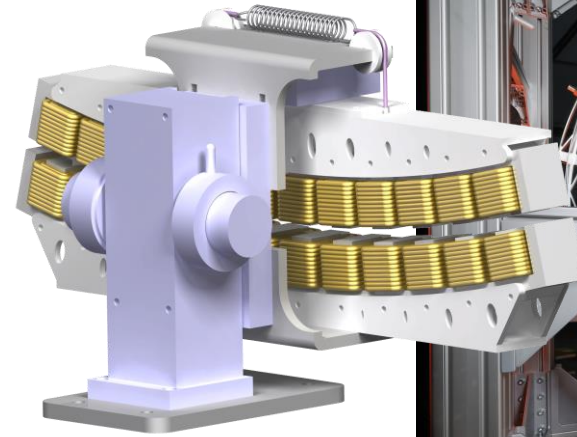- Low Voltage design (sensors)

- Pod Avionics

https://epfloop.ch

Linear induction motor

- Design and optimisation using analytical model
- Design and validation using 2D and 3D Finite Elements Models (FEM)

Operation and extension of the LIM test bench

- High speed measurement
- Build of new motors
- Extention of the bench to new motor types

https://epfloop.ch

Other Labs

- https://www.epfl.ch/labs/bnms/home/students-projects/
- https://www.epfl.ch/labs/desl-pwrs/education/students-projects/
- https://www.epfl.ch/labs/react/page-55873-en-html/
- https://www.epfl.ch/labs/idiap/open-positions/student-projects/
- https://www.epfl.ch/labs/lions/student-projects/