SDU Microelectronics

ICELab

Research and Chip Courses at SDU

14 APRIL 2026 · DTU LYNGBY

DTU Chipday 2026

SDU

SDU Micro | ICELab | Sub-Groups

Biomedical IC Design

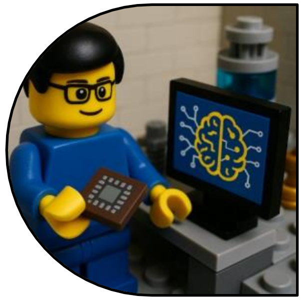
Integrated circuits for medical diagnostics, monitoring, and therapeutic devices.

- Low-power and wearable biosensors
- Implantable and minimally invasive devices
- Analog front-ends for bio-signal acquisition

Cryogenic CMOS

Low-temperature circuit design for quantum systems and ultra-low-noise applications.

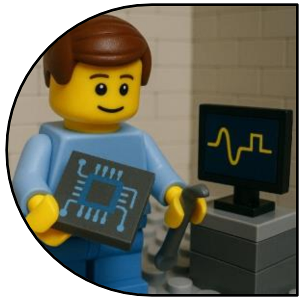
- Operation at 4 K and below
- Readout/control circuits for quantum processors
- Device modeling under cryogenic conditions



Advanced Computing

Neuromorphic, spintronic, and beyond-CMOS computing.

- Neuromorphic computing for data, image, and video processing (Robotics, Drones, etc.)
- In-memory and non-Von Neumann paradigms
- Electronics, Spintronics, and Photonics challenges
- Large language Models on ASIC



Analog Mixed-Signal IC Design

Bridging analog precision with digital flexibility in modern electronic systems.

- High-Precision sensor interfaces for industry
- Low-Power Data converters (ADC/DAC)
- Design trade-offs: speed, accuracy, and power

Power Management IC Design

Enabling intelligent energy control in microelectronic systems through compact, efficient power solutions.

- Ultra-low power DC-DC converters for embedded and IoT platforms
- For Automotive and Space Applications
- High-efficiency and small form-factor solutions
- Battery Health Monitoring

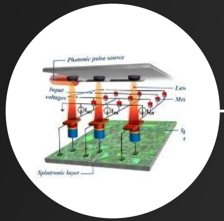
Chip for Space and Security

Design and Implementation of secure and space-grade chips for sensing, processing, and power management.

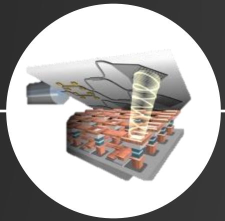
- Hardware Security
- Radiation Hardened, the ability to operate in harsh environments

ICELab Projects

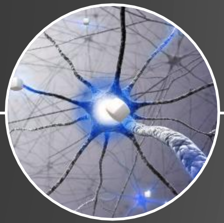
Past and Current



NeuroCoM
€0.24 Million



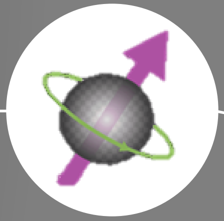
SPICE
€3.4 Million



STARDUST
€3.8 Million

HERMES

HERMES
€8.43 Million



SHADE
€0.2 Million

CorroSense

Corrosense
DKK 26 Million

VELUX FONDEN

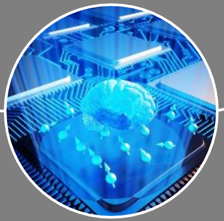
SpinGrain
€2 Million

PipeSense

PipeSense
€2 Million

Innovationsfonden

DigiMon
€0.2 Million



SPINAGE
€4.38 Million

novo nordisk fonden

iSKIN BIO-X
DKK 4 Million

LUNDBECK FONDEN

Neuro-Sense
DKK 2.2 Million

swan on chip

SWAN ON CHIP
€3.2 Million

DONUT

DONUT
€2.6 Million

EPIFY

EPIFY
DKK 23 Million

Chips JU

SPINCHIP
€ 9 Million

Chips JU

ODE4EC_AMS
€ 12 Million

DANMARKS FRIE FORSKNINGSFOND
INDEPENDENT RESEARCH FUND DENMARK

NeuroEar
DKK 3.2 Million

DkCCC
€7.7 Million

MOSAIC

MOSAIC
€53 Million

NeuroMate
DKK 31 Million

SDU

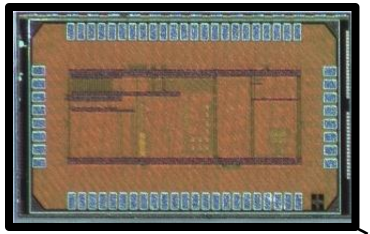
ICELab Selected Projects

PipeSense

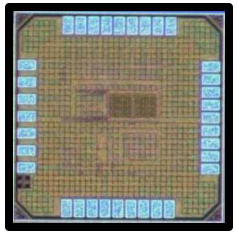
To develop a novel leakage sensing mechanism for precise water leak detection in underground pipes.

SDU Innovationsfonden

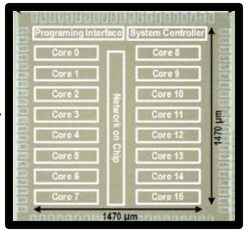
Analog and Digital Time Domain Reflectometry (TDR) Chip
65nm CMOS
7-bit Current DAC
1.3ns Time Error
0.18m Dist. Error
7.5mW A-Power
1.47mW D-Power



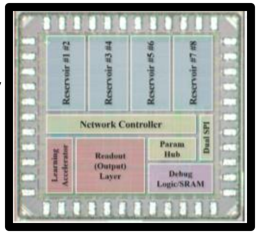
A Fully CMOS Low-Power Temperature Sensor
65nm CMOS
-20°C to +120°C
±1.36°C 3σ Inacc.
0.019 nJK^2 FoM



Digital SNN (AI) NEXUS
28nm CMOS
16-Core FC SNN
LI/LIF Neurons
300MHz Frequency
0.55V Supply
1.54mW Power

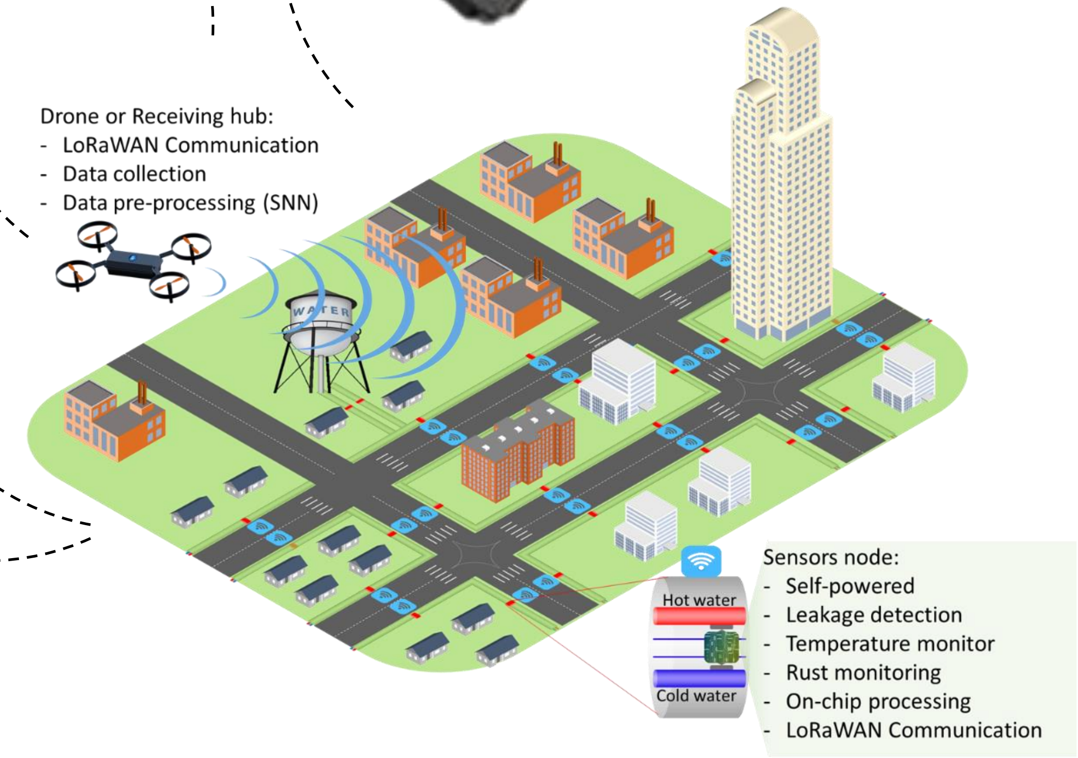


Digital SNN (AI) SPIRE
28nm CMOS
On-chip learning
400MHz Frequency
10pJ/SOP
0.9V Supply



PipeSense Sensor Box

TDR Sensor Chip
Temp. Sensor Chip
Honeywell Sensors
Thermistors (x4)
TEG Energy-Harv.
Power Manag. Unit
1 F Super-Capacitor
ARM Microcontroller
LoRa Module
LoRa Antenna



ICELab Selected Projects

CORROSENSE

Self-powered corrosion monitoring

SDU

Innovationsfonden

If corrosion is detected in an early stage, appropriate actions can be taken to maintain or even increase the service life of structures

- ❑ Low-power (event-based processing)
- ❑ Battery-less (energy harvesting)
- ❑ Accurate (new sensor)
- ❑ Intelligent (edge-computing)
- ❑ Autonomous
- ❑ Wireless
- ❑ Adaptable (future applications, e.g., windmills)

AARHUS UNIVERSITET AU ENGINEERING

Electronics, WP1

AALBORG UNIVERSITET

Communication, WP2

maturix FORCE TECHNOLOGY

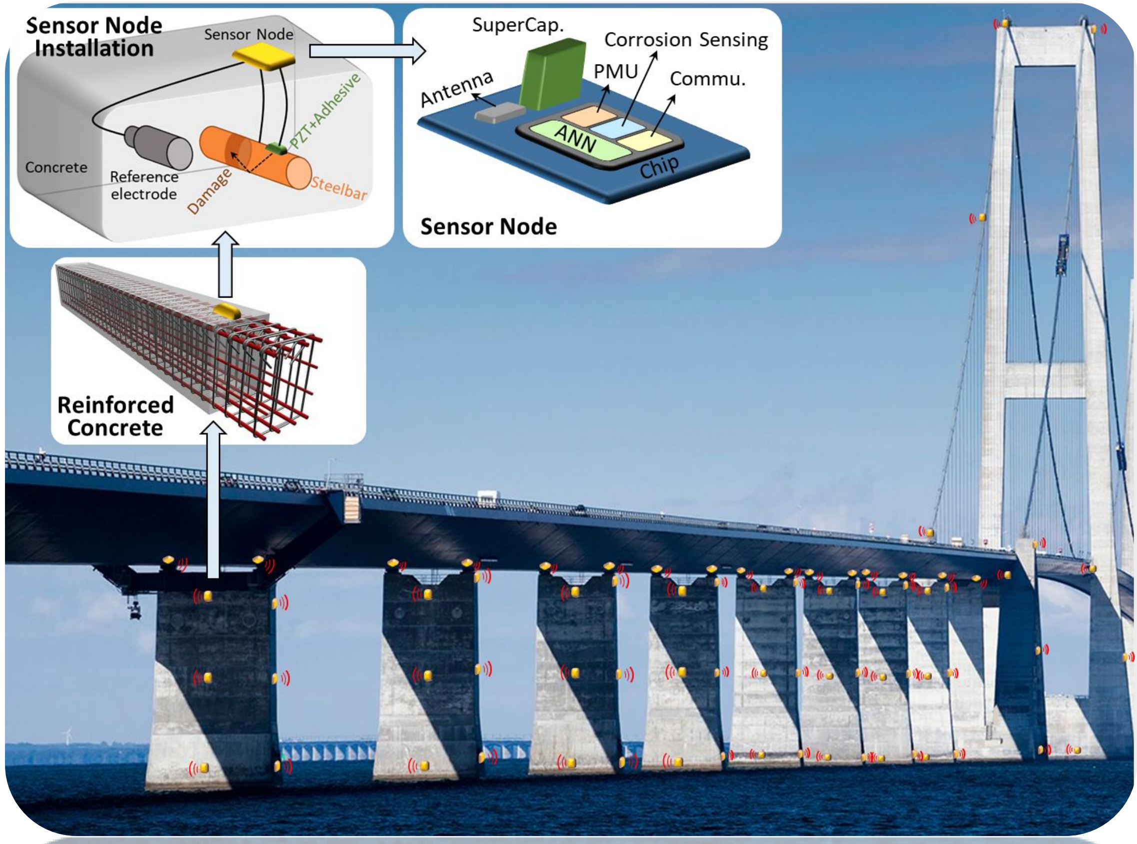
Prototyping, WP3

Sund≈Bælt maturix

FORCE TECHNOLOGY Vejdirektoratet

DAMGAARD RÅDGIVENDE INGENIØRER

Testing, WP4



ICELab Selected Projects

MOSAIC

MOSAIC addresses a grand challenge for European competitiveness: technological independence and filled fabs in the landscape of automated systems. By fostering innovation in Electronic Components and Systems (ECS), ***MOSAIC*** aims to propel Europe to excellence and digital autonomy, directly linked to the EU Chips Act.

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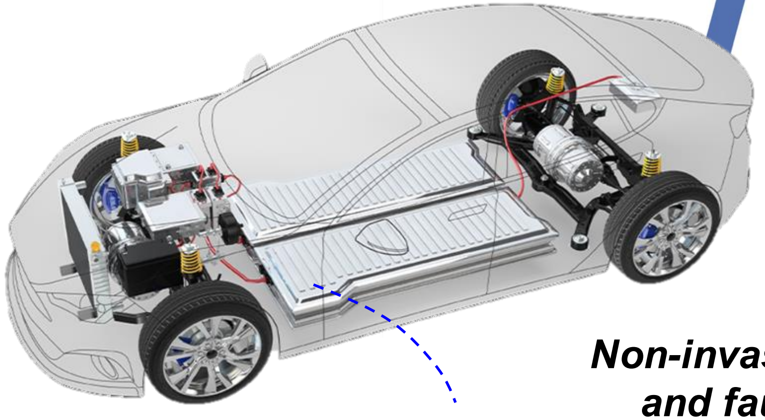
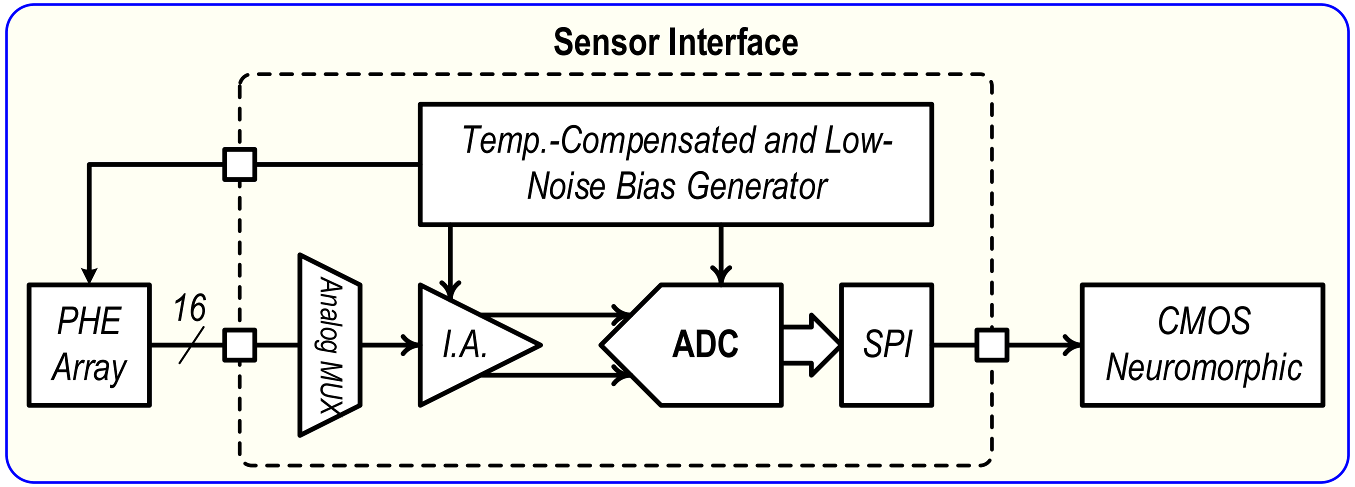
European Commission



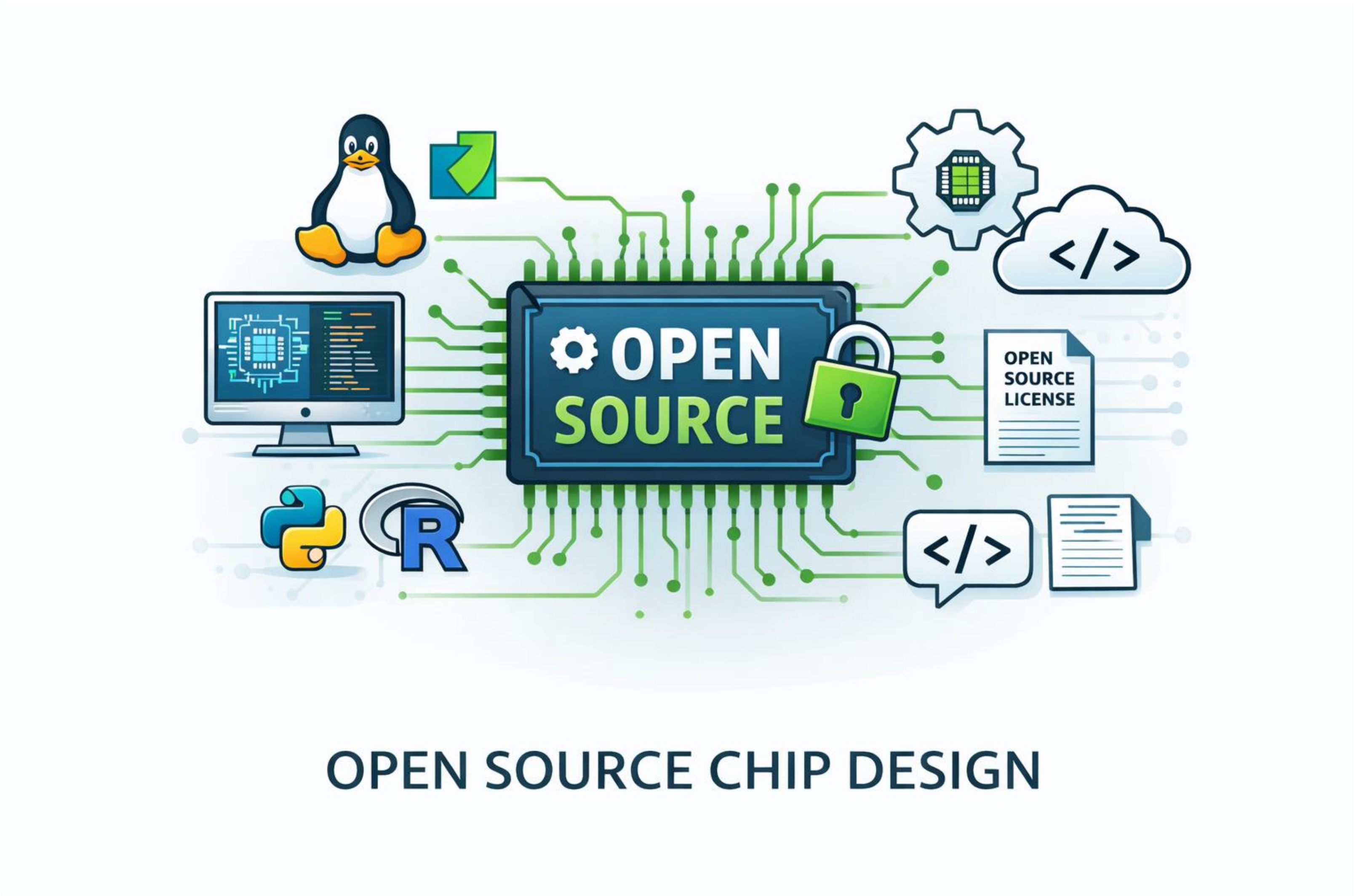
Non-invasive battery current measurement and fault prediction/detection System



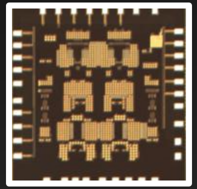
ICELab Selected Projects

ODE4EC_AMS

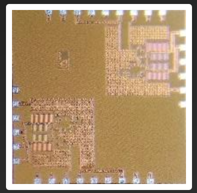
ODE4EC_AMS...



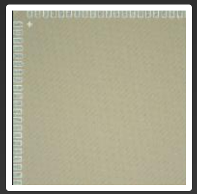
ICELab Selected Chip Gallery



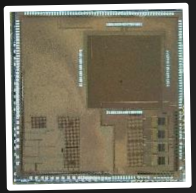
Ear-EEG Signal Readout Channel
In 180nm CMOS



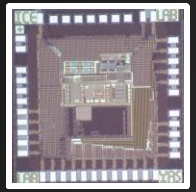
Ultrasonic Power and Data Transmitter
In 180nm HV-BCD



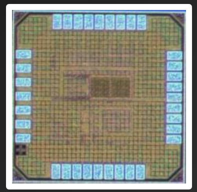
Multi-Core Digital-based SNN
In 28nm CMOS



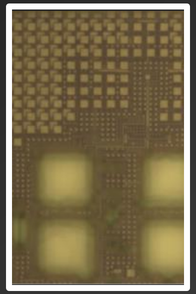
Memristor-based Neuromorphic Computing
In 180nm HV-BCD



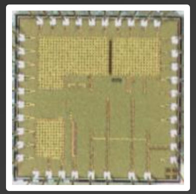
Nano-Oscillator Readout Channel
In 180nm CMOS



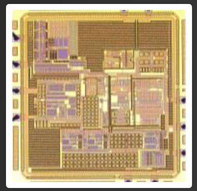
Low-Power Temperature Sensor
In 65nm CMOS



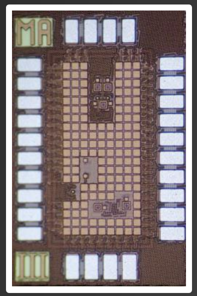
Ultrasonically-Powered Dust for Dual-Wavelength Optogenetic
In 180nm CMOS



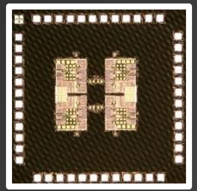
Arbitrary Waveform Biphasic Neural Stimulator
In 180nm HV-BCD



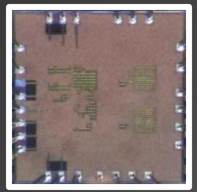
High-Performance Operational Amplifier
In 180nm CMOS



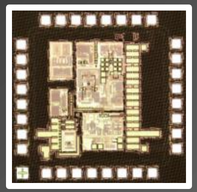
Analog-based Spiking Neural Network
In 180nm CMOS



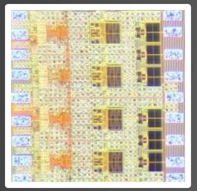
Adaptive Spiking Encoder
In 180nm CMOS



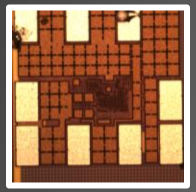
EEG Signal Readout Channel
In 180nm CMOS



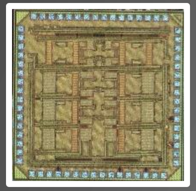
Implantable Closed-loop Neural Stimulator
In 180nm CMOS



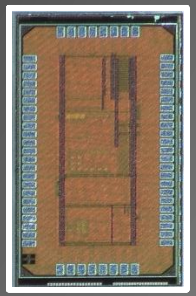
Multi-Channel Neural Recording Amplifier
In 180nm CMOS



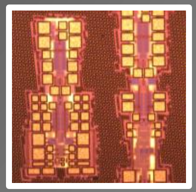
Ultrasonically-Powered Neural System
In 180nm CMOS



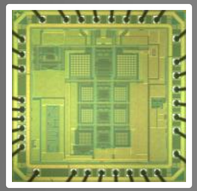
50 MS/s 12-bits Analog-to-Digital Converter (ADC)
In 180nm CMOS



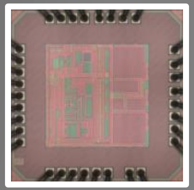
Time-Domain Reflectometry (TDR)-Based Leakage Sensor
In 65nm CMOS



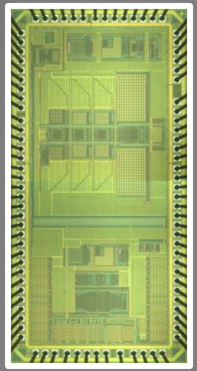
4-Channel Chopping Neural Amplifier
In 180nm CMOS



200Hz Bandwidth 18-bit $\Delta\Sigma$ ADC
In 180nm CMOS



Single Inductor Dual Output DC/DC Buck Converter
In 65nm CMOS



CMOS Interface for Spintronic-Based Wireless Sensor Node
In 180nm CMOS

SDU

EDUCATION
(List of the courses)

Integrated Circuit Design .... 10 ECTS

Analog Circuits and Systems .... 5 ECTS

Data Converters .... 5 ECTS

Neuromorphic Computing .... 5 ECTS

Radio-Frequency Integrated Circuits (RFIC) .... 5 ECTS

Very Large-Scale Integration (VLSI) .... 5 ECTS

Wearable and Implantable Devices .... 5 ECTS

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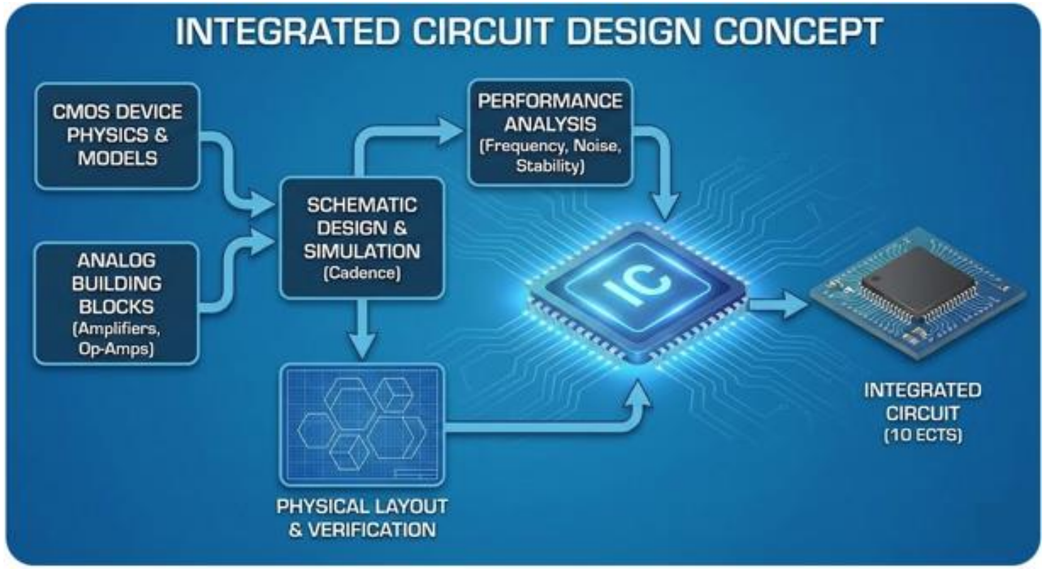
EDUCATION

Integrated Circuit Design

10 ECTS



Aim

- **Core Focus:** Understanding of analog IC design with an emphasis on CMOS
- **Practical Experience:** Hands-on design from the transistor level to layout and post-layout simulations using commercial tools like *Cadence Virtuoso*
- **Approach:** Focuses on intuitive understanding of circuit behavior and practical matters over heavy analytical approaches

Covered Topics

- **Foundations:** MOS Device Physics, Models, and Biasing techniques.
- **Amplifiers:** Single-stage, multi-stage, and differential amplifier analysis.
- **Advanced Design:** Op-Amp design, Feedback, and Frequency compensation.
- **Performance:** Noise analysis and mitigating mismatch effects.
- **Physical Implementation:** Design rules, interconnect parasitics, and testing methods.

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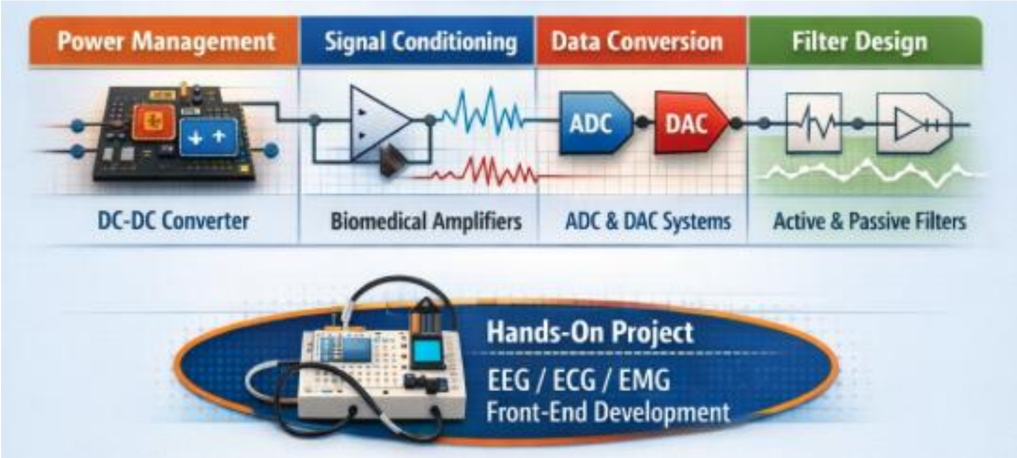
EDUCATION

Analog Circuits and Systems

5 ECTS



Aim

- **Core Focus:** Develops a foundational understanding of analog circuits, electronic devices, and the critical bridge between the analog and digital worlds
- **System Design:** Provides the essential knowledge required to design new circuits or appropriately integrate existing ones into complex systems
- **Approach:** Translates theoretical concepts into practical implementation through extensive laboratory work and project-based learning

Covered Topics

- **Power Management:** Design of DC power supplies, including rectifiers, DC-DC converters, and voltage regulators.
- **Precision Amplification:** Exploration of instrumentation amplifier topologies
- **Biomedical Front-Ends:** Practical development of analog front-ends for EEG, ECG, and EMG signal acquisition systems
- **Signal Acquisition:** Mastery of Nyquist sampling theory and fundamental ADC/DAC structures.
- **Filtering:** Implementation of passive, RC, Gm-C, and Switched-Capacitor filters.

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EDUCATION

Wearable and Implantable Devices

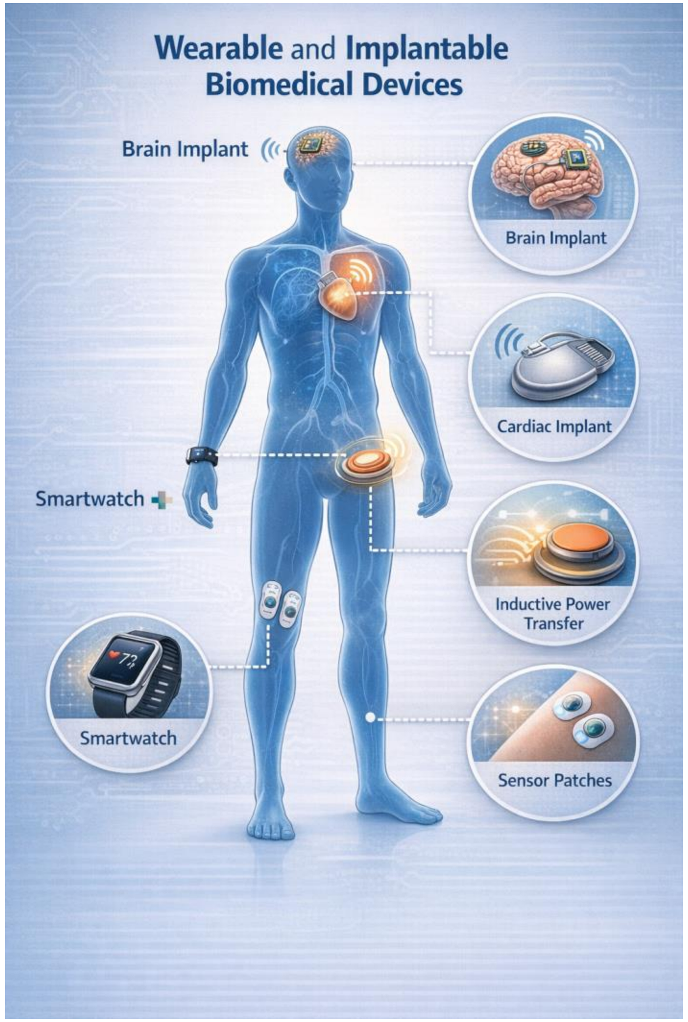
5 ECTS

Aim

- **Core Focus:** A solid understanding of design principles and challenges of miniaturized wearable and implantable electronic devices
- **Low-Power System:** Enables students to analyze, design, and evaluate biomedical systems that integrate sensing, signal processing, and wireless communication
- **Design Constraints:** Emphasizes strict constraints on power consumption, physical size, and computational complexity

Covered Topics

- **Biomedical Electronics:** Comprehensive understanding of medical electronics and interfacing with biological tissues.
- **Power Management:** Specialized focus on energy harvesting (thermal, solar, inductive) and low-power techniques from circuit to architecture level
- **Instrumentation:** Techniques for high-precision, low-frequency signal acquisition.
- **Telemetry:** Wireless data & power telemetry techniques for medical devices
- **Case Studies:** Exploration of state-of-the-art technologies, such as brain implants



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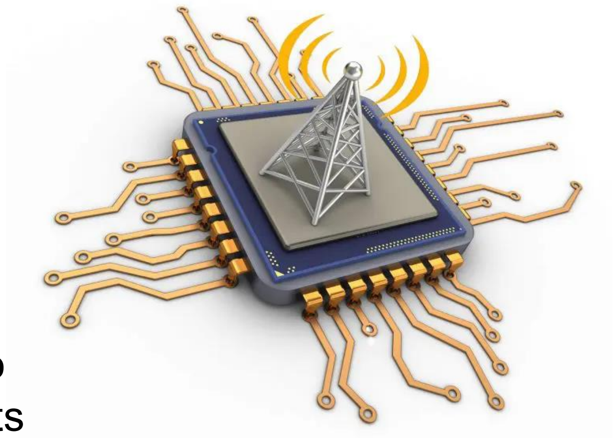
EDUCATION

Radio-Frequency Integrated Circuits

10 ECTS



Aim

- **Core Focus:** Provides fundamental and practical knowledge in designing analog and radio-frequency integrated circuits (RFICs) using modern CMOS technologies
- **System-Level Design:** Students learn to address circuit- and system-level challenges to realize high-performance, low-power RF circuits
- **Practical Applications:** Enables students to apply theoretical principles to the design of complete RF transceiver front-ends for wireless communication systems

Covered Topics

- **RF Fundamentals:** Analysis of RF signals, impedance matching, noise, and nonlinearity.
- **Key RF Building Blocks:** Design of Low-Noise Amplifiers (LNAs), Mixers, Oscillators (VCOs), Power Amplifiers (PAs), and Frequency Synthesizers (PLLs) .
- **System Architecture:** RF transceiver architectures, system partitioning, and design flow using professional CAD tools (Cadence, ADS, etc.)
- **Advanced Implementation:** Layout considerations, parasitic extraction, and emerging trends in high-frequency IC design

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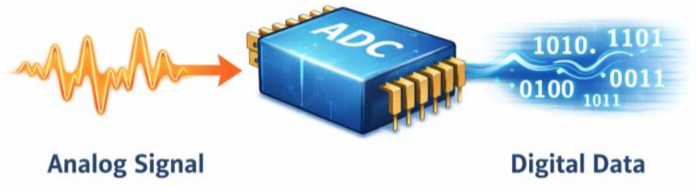
EDUCATION

Data Converters

5 ECTS



Aim

- **Core Focus:** Understanding of data converter design with an emphasis on ADC/DAC architectures
- **Practical Experience:** Hands-on design from the behavioral to transistor level design and simulations using commercial tools like *Matlab* and *Cadence Virtuoso*
- **Approach:** Focuses on intuitive understanding of data converters and practical matters

Covered Topics

- Fundamentals of data conversion and quantization theory
- Sampling theory, aliasing, and anti-aliasing filter requirements
- Static and dynamic performance metrics (INL/DNL, SNR, ENOB, SFDR, THD)
- Reference circuits and clocking for data converters
- ADC architecture: Flash, SAR, Pipeline, Sigma-Delta, Dual-slope
- DAC architecture: R-2R ladder, Current-steering, Charge-redistribution, Segmented DACs
- Error sources, nonidealities, and practical limitations
- Behavioral modeling using MATLAB/Simulink or similar tools
- Interface considerations for mixed-signal systems
- System-level design trade-offs: speed, resolution, power, area, and noise

SDU

EDUCATION

Very-Large-Scale Integrated Circuits (VLSI)

5 ECTS

Aim

- **Core Focus:** In-depth understanding of design principles and technological challenges in Very Large-Scale Integration (VLSI)
- **Practical Experience:** ASIC design flow from transistor to layout
- **Approach:** Combined lecture and exercises taking VHDL codes to chip layout on simulation tools and FPGA

Covered Topics

- Analyze and calculate power consumption in CMOS-based circuits under different conditions.
- Identify and explain the main non-ideal transistor effects and their impact on circuit design.
- Apply design techniques to reduce both static and dynamic power consumption in digital circuits.
- Compare logic families and select suitable implementation methods with respect to power consumption and performance.
- Design and optimize SRAM cells with a focus on low-power consumption.
- Implement and simulate digital neuron models in VHDL, and verify functionality through FPGA-based testing.

SDU

EDUCATION

Neuromorphic Computing

5 ECTS

NEUROMORPHIC
COMPUTING COURSE

Aim

- **Core Focus: I**ntroduction to neuromorphic computing, an emerging paradigm that aims to emulate the structure and function of biological neural systems in electronic hardware in digital, analog and using emerging technologies.
- **Practical Experience:** Hands on experience for design and implementation of different neuromorphic computing concepts on software/hardware
- **From Neuroscience to Computing:** Basic undertanding of neuroscience approaches, translating them into hardware for the prupose of computing

Covered Topics

□Apply theoretical concepts of neuromorphic computing to analyze and model neuron and synapse behavior using mathematical and simulation-based approaches.

□Design and simulation of Analog and Digital neuromorphic circuits and architectures for computing purposes

□Evaluate and compare different neuromorphic algorithms and hardware architectures in terms of computational efficiency, energy consumption, and scalability.

□Integrate knowledge of electronics, computing, and materials to assess the trade-offs between CMOS and beyond-CMOS implementations.

□Communicate technical ideas and results related to neuromorphic systems clearly through written reports, presentations, and project demonstrations.

SDU

SDU Micro ICELab

Our Team

The Team

Farshad Moradi
Professor
Section Leader

Hooman Farkhani
Associate Professor
Deputy Head of Section

Milad Zamani
Associate Professor
CryoCMOS
IC Design

Yasser Rezaeiyan
Associate Professor
Biomedical
IC Design

Yarrolah Kolivand
Senior Chip Designer
Sensor Interfacing
IC Design

Alireza Mosalmani
Assistant Professor
Data Converter
IC Design

Margherita Ronchini
Postdoc
IC Design

Arman Ghouchani
PhD Student
IC Design

Elham Hatamzadeh
Postdoc
IC Design

Mads Kofod
PhD Student
Sensor Interface

Hossein Esmailbeygi
Postdoc
IC Design

Jens M. Bendtsen H.
PhD Student
IC Design

Dario F. Khatiboun
Postdoc
Neuromorphic Computing

Abdul Rehman
PhD Student
IC Design

Simon N. Richter
PhD Student
Energy efficient ML & Accelerators

Sajad Eydivandi
PhD Student
State Space Models

Hoda Fares
Assistant Professor
Neurotechnology (AU)

Roghayeh Aghazadeh
Postdoc
SNN algorithms for biosignals

Ravish Kumar Raj
Postdoc
Spintronics for Advanced Computing

Ali Sahafi
Postdoc
Digital, Mixed/signal IC Design

Amin Aminifar
Postdoc
ML for Biosignal Processing

Ming Zhang
PhD Student
Large Language Models

Peng Weitong
PhD Student
AFE IC design

Wei-Chieh Ma
PhD Student
Cryogenic CMOS

Yaogang Wang
PhD Student
AFE IC Design

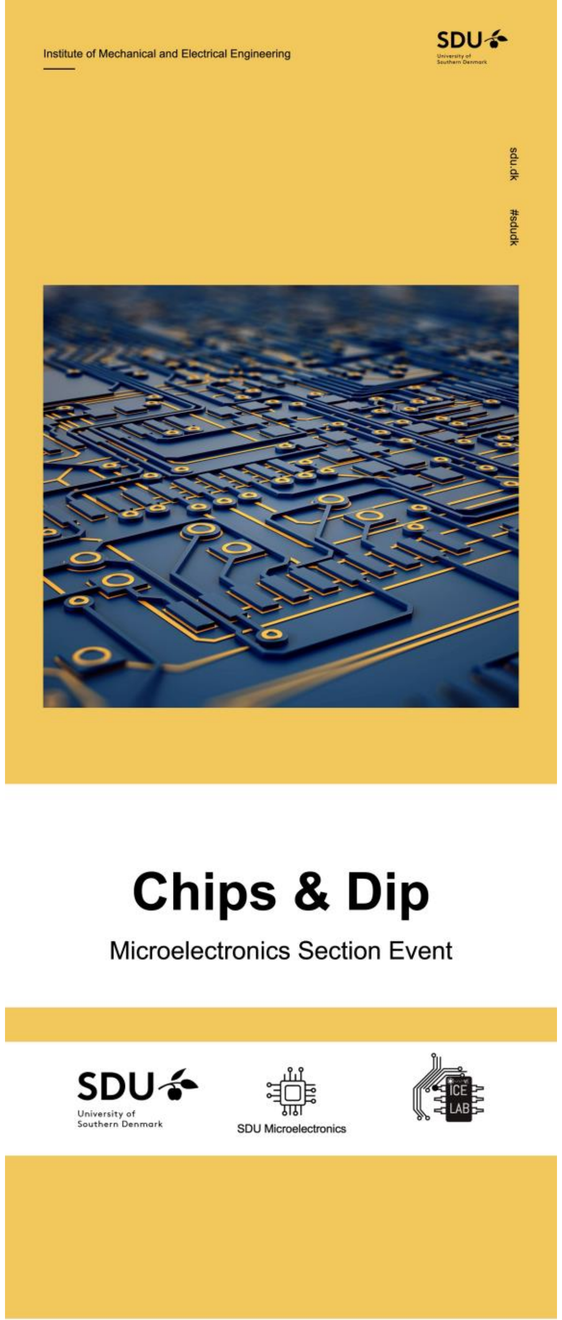
Jorge Luis Vega
PhD Student
Neuromorphic Computing

Jose A. Sanchez Frias
PhD Student
Neuromorphic Computing

Fattaneh FarhadiNia
Engineer
HW Developer

- **Open Assistant Professor** within Photonic Integrated Circuits (Open now)
- **7-8 positions** to be filled by May 2026

SDU



Half-day event at SDU on Chip Design

Date: TBA
Location: SDU Microelectronics, Odense

→ Pitch talks
→ Demonstrations
→ Poster Session
→ & chips!