MS Thesis projects

Updated January 21, 2021

[IoT-CHARM-PV1] Industrial IoT sensors for extremely challenging environments for photovoltaic panels during the fabrication phase.

As part of the European **CHARM** research project, we are working on sensors in extremely challenging industrial environments. In particular we want to develop high temperature and pressure sensors for photovoltaic panels in manufacturing plants. A possible solution is using passive wireless sensors based on silicon carbide, operating in a way similar to an RFID transponder.

Your work consists in

- Understanding the requirements of temperature and pressure sensors for photovoltaic panels during the fabrication phase in collaboration with the manufacturing company (considering both established solutions and advanced research-stage solutions in the technical literature) in terms of accuracy, robustness, speed, precisinon, power supply, operating conditions and data communication
- Understanding the operation of passive wireless sensors.
- Understanding the challenges posed by the operating conditions of a photovoltaic panel fabrication plant (in terms of presence of high temperature, speed, distance, signal propagation, other infrastructures).
- Evaluating and comparing different solutions in a technically sound way.
- Defining the requirements of a passive wireless sensor embedded on the panel and evaluating candidate solutions
- Perform a feasibility study of different possible solutions in order to choose the most promising one.
- Design a demonstrator of passive wireless sensor and of the reader system based on as a mixed-signal PCB and an integrated circuit down to the physical layout level.
- Demonstrate the operation of the designed subsystem on the basis of full simulations (pre and post-layout).

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on industrial internet of thing in extremely challenging environments
- Use of python or matlab for system-level simulation
- Functional block (and sensor) modeling using Verilog-A
- Design of mixed-signal integrated circuits using Cadence Virtuoso
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa, Applied Materials (USA and Italy), Quantavis s.r.l. (SME based in Pisa), TUDelft, and the CHARM consortium.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time

[IoT-CHARM-AP] Industrial IoT sensors for air quality in mines: power transfer subsystem

As part of the European **CHARM** research project, we are working on developing air quality sensors for mines, to automate the climate control and reduce costs related to air quality maintenance.

Your work consists in

- Understanding the requirements of gas sensors for air quality monitoring in collaboration with the mining company (considering both established solutions and advanced research-stage solutions in the technical literature) in terms of power supply, operating conditions and data communication
- Evaluating and comparing different solutions in a technically sound way.
- Understanding the challenges posed by the operating conditions of a mine (in terms of presence of water, dirt, other infrastructures.
- Defining the requirements of the power supply sub-system (likely based on wireless power transfer) and evaluating candidate solutions
- Perform a feasibility study of different possible solutions in order to choose the most promising solution.
- Design a demonstrator of the power supply subsystem as a PCB plus a mixed-signal integrated circuit down to the physical layout level.
- Demonstrate the operation of the designed subsystem on the basis of full simulations (pre and post-layout).

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on industrial internet of thing in extremely challenging environments.
- Use of python or matlab for system-level simulation.
- Functional block (and sensor) modeling using Verilog-A.
- Design of mixed-signal integrated circuits using Cadence Virtuoso.
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa, Sandvik (Finland), Quantavis s.r.l. (small company based in Pisa), and the CHARM project consortium.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time. Thesis work can be stopped at the preliminary circuit design level if needed. Project continues for 4 years.

[IoT-CHARM-AC] Industrial IoT sensors for air quality in mines: communication subsystem

As part of the European **CHARM** research project, we are working on developing air quality sensors for mines, to automate the climate control and reduce costs related to the air quality maintenance.

Your work consists in

- Understanding the requirements of gas sensors for air quality monitoring n collaboration with the mining company (considering both established solutions and advanced research-stage solutions in the technical literature) in terms of power supply, operating conditions and data communication.
- Evaluating and comparing different solutions in a technically sound way.
- Understanding the challenges posed by the operating conditions of a mine (in terms of presence of water, dirt, other infrastructures.
- Defining the requirements of the communication sub-system (also considering solutions based on the modulation of the backscattered radiation) and evaluating candidate solutions
- Perform a feasibility study of different possible solutions in order to choose the most promising solution.
- Design a demonstrator of the communications subsystem first as a printed circuit board and then as a mixed-signal integrated circuit down to the physical layout level.
- Demonstrate the operation of the designed subsystem on the basis of full simulations (pre and post-layout).

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on industrial internet of thing in extremely challenging environments
- Use of python or matlab for system-level simulation
- Functional block (and sensor) modeling using Verilog-A
- Design of mixed-signal integrated circuits using Cadence Virtuoso

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa, Sandvik (Finland), Quantavis s.r.l. (small company based in Pisa), and the CHARM project consortium.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time. Thesis work can be stopped at the preliminary circuit design level if needed. Project continues for 4 years.

[IoT-CHARM-PP] Industrial IoT sensors for paper production equipment: power transfer subsystem

As part of the European **CHARM** research project, we are working on developing industrial sensors for vibration and temperature of rotating parts in paper production equipment to improve predictive maintenance.

Your work consists in

- Understanding the requirements of vibration and temperature sensors for rotating parts in paper fabrication machines in collaboration with the equipment fabrication company (considering both established solutions and advanced research-stage solutions in the technical literature) in terms of power supply, operating conditions and data communication.
- Evaluating and comparing different solutions in a technically sound way.
- Understanding the challenges posed by the operating conditions (in terms of presence of water, temperature, pressure, rotating parts, other infrastructures).
- Defining the requirements of the power supply sub-system (likely based on wireless power transfer) and evaluating candidate solutions
- Perform a feasibility study of different possible solutions in order to choose the most promising solution.
- Design a demonstrator of the power supply subsystem as a PCB plus a mixed-signal integrated circuit down to the physical layout level.
- Demonstrate the operation of the designed subsystem on the basis of full simulations (pre and post-layout).

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on industrial internet of thing in extremely challenging environments.
- Use of python or matlab for system-level simulation.
- Functional block (and sensor) modeling using Verilog-A.
- Design of mixed-signal integrated circuits using Cadence Virtuoso.
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa, Valmet (Finland), Quantavis s.r.l. (small company based in Pisa), and the CHARM project consortium.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time. Thesis work can be stopped at the preliminary circuit design level if needed. Project continues for 4 years.

[IoT-CHARM-PS] Industrial IoT sensors for paper production equipment: communication subsystem

As part of the European **CHARM** research project, we are working on developing industrial sensors for vibration and temperature of rotating parts in paper production equipment to improve predictive maintenance.

Your work consists in

- Understanding the requirements of vibration and temperature sensors for rotating parts in paper fabrication machines in collaboration with the equipment fabrication company (considering both established solutions and advanced research-stage solutions in the technical literature) in terms of power supply, operating conditions and data communication.
- Evaluating and comparing different solutions in a technically sound way.
- Understanding the challenges posed by the operating conditions (in terms of presence of water, temperature, pressure, rotating parts, other infrastructures).
- Defining the requirements of the communication sub-system (also considering solutions based on the modulation of the backscattered radiation) and evaluating candidate solutions
- Perform a feasibility study of different possible solutions in order to choose the most promising solution.
- Design a demonstrator of the power supply subsystem as a PCB plus a mixed-signal integrated circuit down to the physical layout level.
- Demonstrate the operation of the designed subsystem on the basis of full simulations (pre and post-layout).

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on industrial internet of thing in extremely challenging environments.
- Use of python or matlab for system-level simulation.
- Functional block (and sensor) modeling using Verilog-A.
- Design of mixed-signal integrated circuits using Cadence Virtuoso.
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa, Valmet (Finland), Quantavis s.r.l. (small company based in Pisa), and the CHARM project consortium.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time. Thesis work can be stopped at the preliminary circuit design level if needed. Project continues for 4 years.

[IoT-AUTO-S1] System-level design of implantable capsule for colonoscopy.

As part of the European **AUTOCAPSULE** research project, we are working on the development of a wireless robotic capsule for colonoscopy. In particular we are developing the full electronic subsystems for wireless power transfer, wireless communication, sensor data conditioning. This thesis deals with the system-level design of the capsule.

Your work consists in

- Understanding the requirements of a wireless capsule for colonoscopy in terms of sensors (white light camera and ultrasound imaging), power supply, communication in collaboration with the other research partners (considering both established solutions and advanced research-stage solutions in the technical literature).
- Understanding the operation of the capsule
- Understanding the challenges posed by the operating conditions of the capsule in the bowel (in terms of presence of temperature, signal propagation through body tissue, biocompatibility).
- Evaluating and comparing different solutions in a technically sound way.
- Defining the requirements of a micro ultra-sound electronics sub-system and evaluating candidate solutions.
- Perform a feasibility study of different possible solutions in order to choose the most promising one.
- Design the full capsule at the system level in order to design and verify specification of the different sub-systems and blocks.
- Perfom system-level simulations of the capsule in different operating conditions in order to verify feasibility of the capsule as a whole.

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on implantable medical sensors
- Use of python or matlab for system-level simulation
- Functional block (and sensor) modeling using Matlab or Verilog-A
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa, Quantavis s.r.l. (SME based in Pisa), University of Leeds, University of Glasgow, IMEC.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time. Project continues for 4 years.

[IoT-AUTO-P1] Power transfer subsystem of implantable capsule for colonoscopy.

As part of the European **AUTOCAPSULE** research project, we are working on the development of a wireless robotic capsule for colonoscopy. In particular we are developing the full electronic subsystems for wireless power transfer, wireless communication, sensor data conditioning. This thesis deals with the wireless power transfer subsystem.

Your work consists in

- Understanding the requirements of a wireless capsule for colonoscopy in terms of sensors (white light camera and ultrasound imaging), power supply, communication in collaboration with the other research partners (considering both established solutions and advanced research-stage solutions in the technical literature).
- Understanding the operation of the capsule.
- Understanding the challenges posed by the operating conditions of the capsule in the bowel (in terms of presence of temperature, signal propagation through body tissuer, biocompatibility).
- Evaluating and comparing different solutions in a technically sound way.
- Defining the requirements of a wireless power transfer sub-system and evaluating candidate solutions
- Perform a feasibility study of different possible solutions in order to choose the most promising one.
- Design a demonstrator of the power transfer sub-system as a mixed-signal PCB and/or an integrated circuit down to the physical layout level.
- Demonstrate the operation of the designed subsystem on the basis of full simulations (pre and post-layout).

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on implantable medical sensors
- Use of python or matlab for system-level simulation
- Functional block (and sensor) modeling using Verilog-A
- Design of mixed-signal integrated circuits using Cadence Virtuoso
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa, Quantavis s.r.l. (SME based in Pisa), University of Leeds, University of Glasgow, IMEC.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time. Thesis work can be stopped at the preliminary circuit design level if needed. Project continues for 4 years.

[IoT-AUTO-C1] Communication subsystem of implantable capsule for colonoscopy.

As part of the European **AUTOCAPSULE** research project, we are working on the development of a wireless robotic capsule for colonoscopy. In particular we are developing the full electronic subsystems for wireless power transfer, wireless communication, sensor data conditioning. This thesis deals with the wireless communication subsystem.

Your work consists in

- Understanding the requirements of a wireless capsule for colonoscopy in terms of sensors (white light camera and ultrasound imaging), power supply, communication in collaboration with the other research partners (considering both established solutions and advanced research-stage solutions in the technical literature).
- Understanding the operation of the capsule.
- Understanding the challenges posed by the operating conditions of the capsule in the bowel (in terms of presence of temperature, signal propagation through body tissue, biocompatibility).
- Evaluating and comparing different solutions in a technically sound way.
- Defining the requirements of a wireless communication sub-system and evaluating candidate solutions
- Perform a feasibility study of different possible solutions in order to choose the most promising one.
- Design a demonstrator of the communication sub-system as a mixed-signal PCB and/or an integrated circuit down to the physical layout level.
- Demonstrate the operation of the designed subsystem on the basis of full simulations (pre and post-layout).

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on implantable medical sensors
- Use of python or matlab for system-level simulation
- Functional block (and sensor) modeling using Verilog-A
- Design of mixed-signal integrated circuits using Cadence Virtuoso
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa, Quantavis s.r.l. (SME based in Pisa), University of Leeds, University of Glasgow, IMEC.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time (design can be stopped and the preliminary circuit design level if needed). Project continues for 4 years.
- Fellowship from Quantavis s.r.l. is available for the thesis.

[IoT-AUTOU1] Micro-ultra-sound electronics of implantable capsule for colonoscopy.

As part of the European **AUTOCAPSULE** research project, we are working on the development of a wireless robotic capsule for colonoscopy. In particular we are developing the full electronic subsystems for wireless power transfer, wireless communication, sensor data conditioning. This thesis deals with the electronics for micro ultra-sound sensing.

Your work consists in

- Understanding the requirements of a wireless capsule for colonoscopy in terms of sensors (white light camera and ultrasound imaging), power supply, communication in collaboration with the other research partners (considering both established solutions and advanced research-stage solutions in the technical literature).
- Understanding the operation of the micro ultra sound sensing system
- Understanding the challenges posed by the operating conditions of the capsule in the bowel (in terms of presence of temperature, signal propagation through body tissue, biocompatibility).
- Evaluating and comparing different solutions in a technically sound way.
- Defining the requirements of a micro ultra-sound electronics sub-system and evaluating candidate solutions.
- Perform a feasibility study of different possible solutions in order to choose the most promising one.
- Design a demonstrator of the micro ultra-sound electronics sub-system as an integrated circuit down to the physical layout level.
- Demonstrate the operation of the designed subsystem on the basis of full simulations (pre and post-layout).

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on implantable medical sensors
- Use of python or matlab for system-level simulation
- Functional block (and sensor) modeling using Verilog-A
- Design of mixed-signal integrated circuits using Cadence Virtuoso
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa, Quantavis s.r.l. (SME based in Pisa), University of Leeds, University of Glasgow, IMEC.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time. Thesis work can be stopped at the preliminary circuit design level if needed. Project continues for 4 years.

[GaN-Car1] Design of Ultra-Fast Charger module for electric vehicles based on GaN.

As part of the European **PROGRESSUS** research project, we are working on the design and the demonstration of an ultra-fast charger module for electric vehicles based on GaN transistors. The actual ultra-fast charger has to provide a maximum power transfer of 350 KW. We are developing and demonstrating adopting a modular architecture for 20 identical modules in which a single module is capable to deliver 17.5 KW (20:1 scale).

Your work consists in

- Understanding the requirements of a fast charger for electric vehicles and the basic circuit architectures (considering both established solutions and advanced research-stage solutions in the technical literature).
- Understanding the specific characteristics of GaN transistors available in the market
- Evaluating and comparing different circuit solutions in a technically sound way, considering solutions based on Silicon, SiC and GaN transistors.
- Perform a feasibility study of different possible solutions in order to choose the most promising one.
- Design a demonstrator of the ultra-fast charger module at the board level (to tape out).
- Demonstrate the operation of the designed subsystem on the basis of full simulations or measurement (if available).

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on power electronics for electric vehicles.
- Use of python or matlab for system-level simulation
- Device modeling using Verilog-A
- Design of mixed-signal integrated circuits using Cadence Virtuoso
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa and the PROGRESSUS consortium.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time. Thesis work can be stopped at the preliminary circuit design level if needed. Project continues for 3 years.

[GaN-IC1] Monolithic GaN technology for fast charger of electric vehicles.

As part of a bilateral collaboration with **Infineon Villach**, we are performing circuit-level design of a fast charger (for electric vehicles) based on GaN in order to define the technology specifications and library of monolithic GaN integrated circuits and benchmark the achievable performance with respect to traditional solutions.

Your work consists in

- Understanding the specific characteristics of GaN transistors available in the market
- Understanding the state of the art in monolithic GaN technology (considering the technical literature)
- Evaluate possible implementations of a fast charger in different technologies: Si, SiC, discrete GaN, monolithic GaN.
- Evaluating and comparing different circuit solutions in a technically sound way in order to define the requirements for monolithic GaN building blocks (drivers, etc).
- Perform a feasibility study of different possible solutions in order to choose the most promising one.
- Design a demonstrator of the ultra-fast charger module with monolithic GaN (using a preliminary PDK) and with discrete GaNFET (using devices from the literature) down to tape out.
- Demonstrate the operation of the designed subsystem on the basis of full simulations or measurement (if available).

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on power electronics based on GaN.
- Device modeling using Verilog-A
- Design of mixed-signal integrated circuits using Cadence Virtuoso
- Work is a collaboration team in the framework of an industrial collaboration project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa and Infineon.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end. If situation allows part of the work can be performed in Infineon Villach.
- Duration: 5 months full time.

[AI-QUEF-CL] Design of the convolutional layer of a mixed-signal machine learning chip.

As part of the European **QUEFORMAL** research project, we are working on the design of analog integrated circuits for machine learning based on logic-in-memory circuits. In this thesis, we focus on the design of a convolutional layer.

Your work consists in

- Understanding the operation of a deep neural network
- Understanding the operation of neural network integrated circuits based on analog computing or on single-bit digital computing (considering both established solutions and advanced research-stage solutions in the technical literature).
- Evaluating different implementations for a convolutional layer of a neural network at the system level (using python or matlab) and comparing them in a technically sound way
- Perform a system-level feasibility study of different possible solutions in order to choose the most promising one.
- Design a demonstrator of the convolutional layer down to the physical level (to tape out).
- Demonstrate the operation of the designed subsystem on the basis of full simulations (pre- and post-layout).

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on machine learning chips.
- Use of python or matlab for system-level simulation
- Device modeling using Verilog-A
- Design of mixed-signal integrated circuits using Cadence Virtuoso
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa, Quantavis (SME based in Pisa) and the WASP consortium.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time. Thesis work can be stopped at the preliminary circuit design level if needed. Project continues for 3 years.

[IoT-WASP-SS] System-level design of a flexible printed wireless health sensor

As part of the European **WASP** research project, we are working on the design of wireless sensors printed on paper or another flexible substrate. In this thesis, we focus on the system-level design of the full sensor-reader system.

Your work consists in

- Understanding the state of the art of printed electronics
- Understanding the operation of a wireless sensors using printed components
- Evaluating different implementations of semi-passive and passive wireless sensors using printed components and hybrid CMOS solutions and comparing them in a technically sound way.
- Perform a system-level feasibility study of different possible solutions in order to choose the most promising one.
- Perform a full-scale system-level design of the sensor-reader system in order to evaluate the effect of non-ideality on operation (noise, non-linearity, mismatch, crosstalk, orientation, propagation).
- Demonstrate the performance in terms of accuracy and range of operation based on system level simulations.

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on printed electronics and wireless sensors.
- Use of python or Matlab for system-level simulation
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa, Quantavis (SME based in Pisa) and the WASP consortium.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time. Thesis work can be stopped at the preliminary circuit design level if needed. Project continues for 3 years.

[AI-QUEF-SL] System-level design of an analog neural network chip.

As part of the European **QUEFORMAL** research project, we are working on the design of analog integrated circuits for machine learning based on logic-in-memory circuits. In this thesis, we focus on the system-level design of the full analog neural network.

Your work consists in

- Understanding the operation of a deep neural network
- Understanding the operation of neural network integrated circuits based on analog computing or on single-bit digital computing (considering both established solutions and advanced research-stage solutions in the technical literature).
- Evaluating different implementations for the analog neural network at the level of functional blocks and comparing them in a technically sound way.
- Perform a system-level feasibility study of different possible solutions in order to choose the most promising one.
- Perform a full-scale system-level design of the neural network in order to evaluate the effect of non-ideality on network operation (noise, non-linearity, mismatch, cross-talk).
- Demonstrate the performance in terms of accuracy and power consumption of the network based on system level simulations.

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on machine learning chips.
- Use of python or matlab for system-level simulation
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa, Quantavis (SME based in Pisa) and the QUEFORMAL consortium.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time. Thesis work can be stopped at the preliminary circuit design level if needed. Project continues for 3 years.

[CYBER-QUEF-PUF] Design of a physical unclonable function chip for secure key generation.

As part of the European **QUEFORMAL** research project, we are working on the design of mixed-signale integrated circuits for secure cryptographic key distribution based on logic-in-memory circuits. In this thesis, we focus on the design of a physical unclonable function (PUF) demonstrator.

Your work consists in

- Understanding the operation of a PUF and of possible implementations (considering both established solutions and advanced research-stage solutions in the technical literature).
- Understanding the details of cryptographic key generation, use, and distribution.
- Evaluating different implementations and comparing them in a technically sound way.
- Perform a system-level feasibility study of different possible solutions in order to choose the most promising one.
- Design the demonstrator of a CMOS PUF down to the physical level (to tape out)
- Demonstrate the operation of the designed subsystem on the basis of full simulations (pre and post-layout).

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Definition of an Industry-level feasibility study.
- Domain knowledge on hardware cyber security systems.
- Use of python or matlab for system-level simulation.
- Device modeling using Verilog-A
- Design of mixed-signal integrated circuits using Cadence Virtuoso
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa, Quantavis (SME based in Pisa) and the QUEFORMAL consortium.
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time. Thesis work can be stopped at the preliminary circuit design level if needed. Project continues for 3 years.

[INFN-PM] Acceleration of image reconstruction using low-resolution pattern machine and high resolution scalar products

Application of associative memory ASICs and FPGAs to perform pattern matching and scalar products with high degree of parallelization enabling extremely fast image reconstruction. The context is high-energy physics experiments (ATLAS) and magnetic resonance imaging.

Your work consists in

- Development of firmware for the test of a pattern reconstruction motherboard with Intel Stratix 10 MX FPGA and 20 associative memory ASICs,
- Using of this firmware in the reconstruction of traces in ATLAS events at the Large Hadron Collier (HTT) and for the reconstruction of magnetic resonance images [arxiv:2010.16207]

Skills you learn:

- Literature research, preparation of a briefing to guide decision making
- Using and programming the Intel Stratix 10 MX FPGA
- Using and programming the associative memory ASICs
- Working knowledge of extremely complex motherboard
- Work is a collaboration team in the framework of an international research project.

Execution of the thesis work:

- The thesis work is part of collaborative task among the University of Pisa and INFN
- The work will be performed fully or largely in a remote way until Covid19 emergency measures end.
- Duration: 5 months full time. Project continues for 3 years. Possibility