



PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 39th cycle

Research Area n. 2 - Electronics

PNRR 117 Research Field: ADVANCED CODING FOR DIFFERENTIAL PCM ENVN

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

The automotive industry is undergoing a deep transformation, driven by disruptive technological innovation in the fields of Electrification. Despite the diverse areas of innovation, they rely on Microcontrollers to perform safe computation and secure data transmission. As the applications evolve, the demand on high computation, lower power consumption and larger memory footprint is driving the automotive MCU technology development. Embedded NonVolatile Memory (e_NVM) is one of the most challenging topics: MCUs are requested to store more data to host more complex firmware. Real time requires fast access to code memory and more complex security software requires peculiar NVM array partitioning. In case of advanced CMOS platform, facing huge process complexity growth while shrinking, among all the resistive memories proposed nowadays as innovative solutions able to replace Floating Gate cells, PCM is the only one demonstrated to be compliant simultaneously with automotive requirements. In NVM area density is a key enabler. In PCM memory the bit is differential so 2 cells are needed for a single bit (to sustain the physical intrinsic drift of the I-V characteristic). An adequate error correcting code (ECC) is also need to get a proper BER.

In this scenario, the main goal of the PhD research is to elaborate an innovative coding for differential memory, preserving the intrinsic robustness (in term of reliability) of



	preserving the intrinsic robustness (in term of reliability) of the symbols. This encompass NVM state definition, sense amplifiers for reading the cells and finally ECC detection and correction. Ultimate aim is to save a relevant fraction of the physical memory array (>25%) while preserving the same information content of a pure differential memory approach (2 cells – 1 bit).
Methods and techniques that will be developed and used to carry out the research	NVM cell reading for fast access time Cells current processing for multi (>3) cells simultaneous reading ECC coding develop for multi bit (>1b) symbols ECC implementation for fast combinatorial decoding access
Educational objectives	To acquire and/or consolidate knowledge and/or practical skills around: Design and verification (analog & digital) ECC coding (matlab & Verilog) Modeling and simulation at the system-on-chip level
Job opportunities	The research proposal addresses an output profile that responds to the needs of the automotive industry for technical experts in the design and the development of next generation of automotive NVM solutions.
Composition of the research group	1 Full Professors 0 Associated Professors 3 Assistant Professors 8 PhD Students
Name of the research directors	Daniele Ielmini

Contacts	
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	STMicroelectronics
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	CEA LETI
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
EDUCATIONAL ACTIVITIES (purchase of study books and material, including computers, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student COMPUTER AVAILABILITY: individual use DESK AVAILABILITY: individual use