POLITECNICO DI MILANO

PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 41st cycle

Research Area n. 2 - Electronics

THEMATIC Research Field: TOWARDS ULTRASOUND SENSING AT SHORT DISTANCE: ELECTRONICS, ALGORITHMS AND APPLICATIONS

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 objective of the research project is to develop a miniaturized ultrasound sensing system targeting high-resolution distance ranging and contactless bidimensional mapping of moving targets at short distance (~10 mm) in air. The motivation lies in the promising performance offered by arrays of ultrasound MEMS transducers, as well as by the advancements in digital signal processing, including novel techniques based on machine learning. Applications of this technology are broad and potentially span from robotics to wearables.
Methods and techniques that will be developed and used to carry out the research	The research will develop following 3 pillars: (1) architecture optimization, (2) signal processing (the core of the activity) and (3) electronics. (1) The array of sensors, their positioning and driving/sensing strategies (such as beam forming) will be studied and optimized by means of finite-element simulations to maximize the sensitivity. (2) Novel high-resolution algorithms for processing echoes to extract the distance and target information, rejecting artifacts and improving SNR, potentially at low-power, will be developed and validated in prototypal setups. (3) Along with a consolidation and improvement of the currently heterogeneous test setup (including ASICs, FPGA and discrete components), the future integration of in ASICs of most of the developed

	processing solution will be evaluated.
Educational objectives	The educational objectives are multiple: (1) strengthening a vertical expertise on MEMS ultrasound sensors and processing, (2) opening the candidate to cross-disciplinary research, including academic and industrial R&D perspectives, (3) learning to self-organize, lead a research project, interact with several other teams, disseminate technical results.
Job opportunities	PhD candidates with expertise sensors, MEMS, ultrasounds and embedded signal processing are highly requested by companies developing electronic systems in multiple application areas spanning from industry, IoT, to acoustics and medical domains. Design of integrate ASIC to manage both transmission and receiving chain completes the know-how that will developed in this research.
Composition of the research group	1 Full Professors 2 Associated Professors 0 Assistant Professors 10 PhD Students
Name of the research directors	Prof. Marco Carminati

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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

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

TEACHING ASSISTANTSHIP: availability of funding in recognition of supporting teaching activities by the PhD student
There are various forms of financial aid for activities of support to the teaching practice.
The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

COMPUTER AVAILABILITY:
1st year: Yes
2nd year: Yes
3rd year: Yes

DESK AVAILABILITY:
1st year: Yes
2nd year: Yes
3rd year: Yes

The research activity will be carried out both in the labs of Politecnico di Milano and of STMicroelectronics.