



PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 37th cycle

Research Area n. 4 - Telecommunications

**THEMATIC Research Field: CHARACTERIZATION, MODELING AND LINEARIZATION OF
MEMS LOUDSPEAKERS**

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

MEMS Loudspeakers represent an emerging technology with tremendous potential in the field of commercial audio systems (flat panel TVs, smartphones, etc.). The early prototypes of such transducers, however, still exhibit sub-par behavior and require improved predictive simulation strategies, and signal processing algorithms for pre-conditioning the input signals in order to achieve high-end rendering quality. The proposed research theme concerns the development of methodologies for characterizing MEMS loudspeakers through specific acoustic/electroacoustic measurements; the development of reliable and accurate mathematical models for such transducers; and the development of signal processing solutions aimed at improving the rendering quality of such transducers, possibly aimed at linearizing their behavior.

Methods and techniques that will be developed and used to carry out the research

This doctoral program will initially explore advanced simulation methods based on finite elements, finite differences, and/or boundary elements, applied to MEMS speaker designs proposed by ST Microelectronics. Data-driven solutions based on machine intelligence will then be explored in order to speed up such simulation solutions. In order to develop methods for the compensation of nonlinearities of MEMS speakers, the activity will focus on developing an equivalent lumped-



	parameter method (an equivalent electrical circuit) of the MEMS speaker, so that nonlinear Wave Digital Filtering (NL-WDF) methodologies can be used for circuit inversion and nonlinearity compensation through predistortion. The required expertise is therefore multidisciplinary, as it will cover areas of sound analysis, synthesis, and processing; computational acoustics; and electroacoustics.
Educational objectives	As part of the doctoral program, the student is expected to acquire in-depth expertise on multi-physics numerical simulation, mathematical modeling of physical systems, space-time signal processing, applied acoustics and electroacoustics.
Job opportunities	At the end of his/her training, the doctoral candidate will be able to successfully work in whatever industrial research facilities devoted to all aspects of computational acoustics, electroacoustics, and acoustic signal processing.
Composition of the research group	2 Full Professors 1 Associated Professors 2 Assistant Professors 8 PhD Students
Name of the research directors	Augusto Sarti

Contacts
augusto.sarti@polimi.it

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	564.01 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
LIST OF UNIVERSITIES, COMPANIES, AGENCIES AND/OR NATIONAL OR INTERNATIONAL INSTITUTIONS THAT ARE COOPERATING IN THE RESEARCH: ST Microelectronics; 2.



INVENTVM

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 per year

2nd year: euros per student (1534)

3rd year: euros per student (1534)

TEACHING ASSISTANSHIP: (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: Laptop + Computing clusters in the ISP Lab

2nd year: Laptop + Computing clusters in the ISP Lab

3rd year: Laptop + Computing clusters in the ISP Lab

DESK AVAILABILITY:

1st year: *Desk in Open or Office Space at DEIB-PoliMI*

2nd year: *Desk in Open or Office Space at DEIB-PoliMI*

3rd year: *Desk in Open or Office Space at DEIB-PoliMI*