POLITECNICO DI MILANO

PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 40th cycle

Research Area n. 4 - Telecommunications

THEMATIC Research Field: INTEGRATION OF RADAR SENSING AND DATA COMMUNICATION AT MMWAVES AND SUB-THZ FREQUENCIES FOR SMART GLASSES

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	Smart glasses, enhanced with augmented reality (AR), are an emerging technology where virtual information is added to the user's field of view. Recent years have witnessed a growing research interest in the definition of the technological solutions for AR smart glasses. This has been mainly driven by the several envisioned applications across various sectors, such as industrial operations, healthcare, and everyday activities.An essential characteristic that AR smart glasses must have is the ability to track eye movements, including the orientation, velocity, and range of the eyes' motion, and the focal point of the gaze. This feature is achieved through the use of sensors implementing different technologies. A commonly used technology relies on the use of optical sensors, i.e. cameras. However, the process of image analysis through cameras is not exempt from errors. In fact, the susceptibility to environmental factors and a significant reliance on lighting conditions can greatly compromise the effectiveness of the system and heighten the probability of error. Additionally, the use of cameras introduces issues of privacy, which significantly diminishes the attractiveness of this technology for use in personal spaces.In order to overcome the above issues, we are assisting to a massive growth of radar systems for eye-tracking.

	The capacity to measure sub-millimeter displacements and to offer unique sophisticated information, such as the target micro-Doppler signatures, are well-known benefits of portable radars. These information is delivered with exceptional precision, while maintaining the user's privacy and offering excellent compatibility with conventional technologies. Furthermore, radar systems stand out from optical systems because to their extreme durability and dependability in the face of ambient light.The goal of the research is the design and development of a radar-based eye tracking system. Innovative methods for sensing and communication will be explored, which can be seamlessly incorporated into the compact design of smart glasses. Advancements in sensing technologies within the millimeter-wave (mmWave) and sub-THz frequencies will allow chip manufacturers to integrate entire radio-frequency systems, including antennas, on a single chip with a small form factor.
Methods and techniques that will be developed and used to carry out the research	The research methodology shall include: 1) Review of the existing literature for eye-tracking with millimeter-wave radar glasses. 2) Evaluation of frequency modulated continuous waveform (FMCW) radar-based eye tracking systems working at mmWave and sub-THz frequencies for joint sensing and communication applications. 3) Design and implementation of a simulation framework for realistic performance analysis of the radar-based eye tracking system. 4) Study and development of novel suitable waveforms for joint sensing and communication for eye-tacking systems. 5) Performance evaluation of designed algorithms and development of a proof-of-concept.
Educational objectives	1) acquire an expertise in technologies for AR smart glasses; 2) develop state-of-the-art skills concerning the integration of sensing and communication at mmWave and sub-THz frequencies; 3) disseminate research results (oral presentations/written

	publications); 4) ability to identify research problems and to conduct research in a highly focused fashion; 5) develop team working skills through the collaboration with the research groups on both theoretical and practical topics; and 6) develop skills for life-long learning and professional development.
Job opportunities	This PhD research project will be conducted within the framework of “Joint Research Center” activities that Politecnico di Milano and EssilorLuxottica are carrying out. For the ambitious and disruptive objectives of the research, it is expected that after completion of the PhD programme the candidate will be ready for being part of any research team in public and private institutions and centers, universities, and industry.
Composition of the research group	0 Full Professors 2 Associated Professors 3 Assistant Professors 5 PhD Students
Name of the research directors	Prof. Maurizio Magarini and Prof. Luca Barletta

Contacts
maurizio.magarini@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	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): financial aid per PhD student. 5.707,20 Euro

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