Politecnico di Torino

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ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

PNRR - Pervasive user-centric radar sensing applications

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Context of the research activity	Radar technology has recently been evolving towards patterns guaranteeing high performances for a multitude of functions, ranging from targets detection, classification, and identification to tracking, and high-accuracy localization. In real life, radar sensors are ubiquitous and one of their main advantages, compared, for instance, to cameras, is that they can work in all weather and light conditions. Nowadays, the advances in mmWave technologies and digitalization allow us to build very high-performance radar sensors that are low-cost, low-power, and of small dimension. PNRR M4C2, Investimento 1.3 - Avviso n. 341 del 15/03/2022 - PE0000001 RESearch and innovation on future Telecommunications systems and networks, to make Italy more smart (RESTART) - CUP E13C22001870001
Objectives	Multidimensional imaging radar solution is the next generation of radar technology that will fill the gap to make lifesaving real-time decisions in all application scenario. The technology detects and tracks people and objects in real time, inside and outside vehicles. Unlike traditional radar solutions, multidimensional imaging radar leverages a Multiple Input Multiple Output (MIMO) antenna array for high-resolution sensing of its surroundings. It generates 3D imaging that can track multiple targets. The technology combines other dimensions, like Doppler and micro-Doppler, to bring additional information. The technology's core strength is resolution enhancement in all dimensions which enables the detection and tracking of multiple static and/or dynamic targets simultaneously. Indoor, this technology detects people, classifies children and adults, monitors vital signs, and detects posture and position. Outdoor, it detects and tracks vehicles, obstacles, and vulnerable road users. Radar-On-Chips (ROCs) comprise several mmWave transceivers. The ROCs combine circuitry to generate a variety of radar signals within the mmWave bands, transmitting them from multiple antenna elements and

	simultaneously recording several coherently received signals. ROCs can also be cascaded to further improve radar performances. The ROCs are usually equipped with DAC, ADC, and memory to collect and process the received data, and by powerful on-chip DSP processors. The on-chip processing of the radar data compresses it into target and event information that can be conveyed over data network to other computers implementing AI techniques. Design, prototyping, and validating high-resolution multidimensional mmWave imaging, radar applications allow accurate detection and classification of multiple static and/or dynamic targets indoor and outdoor. Exploiting the unique technological advances in mmWave multichannel ROCs, in antenna technology and in signal modulation and processing create solutions that provide a new level of safety and robustness.

Skills and competencies for the development of the activity	Software engineering, radar fundamentals, embedded system hardware and software development