ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

DET - Deep Multimodal Image Processing

Funded By	Dipartimento DET
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Context of the research activity	This Ph.D. scholarship delves into cutting-edge research at the intersection of computer vision and artificial intelligence. Focused on advancing image processing and understanding, the project explores innovative deep learning techniques to seamlessly integrate and analyze diverse image acquisition modalities such as optical, depth, radar.
Objectives	The Ph.D. scholarship focuses on novel approaches to image processing and analysis through the integration of diverse acquisition modalities. The primary objectives of this research activity encompass the exploration of advanced deep learning methodologies to unlock the full potential of multimodal image data. One key focus is on enhancing image understanding across various domains, including but not limited to smartphone cameras, and satellite imagery. By leveraging deep learning techniques, the goal is to develop intelligent algorithms capable of seamlessly integrating information from different image modalities. This integration aims to provide a more comprehensive and nuanced understanding of complex scenes, contributing to advancements in fields where accurate interpretation of visual data is paramount. Furthermore, the research activity aims to address the inherent limitations of unimodal approaches. By harnessing the power of deep multimodal frameworks, the objective is to extract richer, context-aware representations from the combined information. This not only improves the accuracy of image analysis tasks but also enables the model to discern subtle patterns and correlations that might be overlooked in unimodal settings. A pivotal aspect of the research involves image restoration through the fusion of depth and optical images. Traditional image processing methods often struggle with the complexities introduced by diverse modalities. This scholarship aims to overcome these challenges by developing innovative algorithms that leverage the complementary strengths of depth and optical information. By fusing these modalities, the research seeks to enhance

	image quality, reduce noise, motion blur and other visual artefacts to improve overall visual clarity. This is particularly important for images acquired by smartphones under low light conditions where active instruments such as Lidars can support traditional cameras. In other fields, such as satellite imagery, different acquisition techniques such as hyperspectral and synthetic aperture radar provide complementary information about a scene but current models are limited in their ability to combine the information. As part of the scholarship, successful candidates will engage in hands-on research, developing and implementing state-of-the-art deep learning architectures and training processes. Additionally, the research will involve the investigation of efficient designs to facilitate the adoption of models directly on the devices acquiring the images.

Skills and competencies for the development of the activity	Ideal candidates have a strong background in mathematics and experience with deep learning and artificial neural networks. Previous experience on improving the efficiency of neural networks, e.g. via quantization, is also desirable.