Mediterranean Thematic Workshops in Advanced Molecular Imaging

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Challenges in AI applied to medical image analysis in COVID-19 infection

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In recent years, the intersection of Artificial Intelligence (AI) and medical imaging has significantly advanced our capabilities in analyzing and understanding complex health issues. However, the lack of fully explainable and trustworthy AI systems still represents a big limitation in the effective deployment of AI tools in the clinical setting. The role of AI in enhancing image analysis for the detection and characterization of COVID-19 infection was explored, identifying three main challenges related to explainability and trustworthiness: the difficulty in explaining the deep model decision, the difficulty in providing a clinically meaningful explanation, and the robustness issues that impede the full trustworthiness. Three different applications focused on the COVID-19 use case were developed and, in each application, a possible solution to each of these three main challenges was investigated. A fully automatic Deep Learning (DL) pipeline has been developed to predict the degree of severity of patients from chest X-rays and associated clinical data, exploring the possibility of explaining the prediction by using a visualization technique. A DL-based quantification software for the characterization of COVID-19 infection visible in Computed Tomography (CT) images was set up to produce quantitative indices representing qualitative characteristics immediately understandable to radiologists. It was validated in a multicenter study. Finally, a Machine Learning pipeline was developed for the prediction of the patient's severity grade from the radiomic features extracted from CT images. Particular attention was paid to the possibility of harmonizing data, also through a study based on CT acquisitions of a phantom. In each application, a trade-off between a good prediction/quantification performance and an improvement in the explainability (XAI) and reliability of the developed AI model was reached. In conclusion, AI-based methodologies were investigated involving other relevant phases beyond modeling, such as data preprocessing and post-processing of results using XAI approaches of medical relevance.

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Session Classification: Can AI/ML/Deep Learning contribute to Molecular Imaging of Inflammation and Infection?