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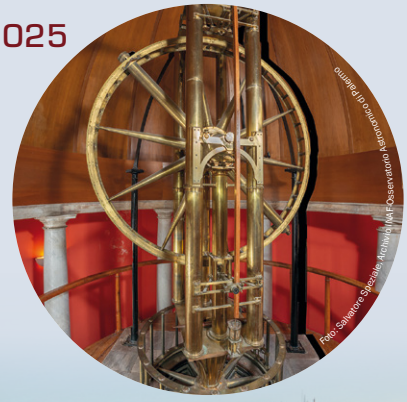

Università degli Studi di Palermo

INTERNATIONAL YEAR OF Quantum Science and Technology

Polo Didattico del Campus dell'Università di Palermo

A cura di Barbara Alzani, Marco Bellacosa e Giovanna Bianchi Bazzi
Redazione dei testi a cura di Barbara Ancarani e Marco Bellacosa
Progetto grafico a cura di Simona Oleandri

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situ applications, the system is fully portable and optimized for use at significant heights and on scaffolding. Over recent years, it has been successfully employed in diagnostic campaigns on historical wall paintings in Italy, as part of broader multi-instrument analysis and conservation projects.

Comunicazioni

Neural network-based segmentation of dentate nuclei from 3T b0 brain images: a semi-supervised approach.

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The dentate nuclei (DN) of the cerebellum are essential for communication with the brain and are part of the Dentate Rubro-Talamic (DRT) Tract, involved in movement disorders such as Essential Tremor (ET). Accurate DN segmentation is crucial for clinical and research applications. Traditional methods like manual delineation or atlas-based approaches are time-consuming and variable. Some use uncommon MRI sequences, like susceptibility-weighted imaging. In young adults, B0 images at 3T offer a more accessible option. In this study, we implemented a semi-supervised method to segment DN on 3T b0 DWI images, which are widely available. A fully Convolutional Neural Network was developed using T1 and b0 images. HCP dataset images were used to generate binary masks for training. Performance was compared to a model based on nnUNet. Preliminary results showed a Dice Score (DS) of 0.85 ± 0.05 for our model vs. 0.83 ± 0.08 for nnUNet, indicating high accuracy. Our method is promising for planning neurosurgical treatment of essential tremor.

Label-free sensing of soluble biomolecules using pixeled SEIRA and site-specific vibrational probes.

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Spectrochemical analysis of trace elements in complex matrices is critical but often hindered by background noise and the challenge of detecting analytes at ultralow concentrations. Surface-Enhanced Infrared Absorption (SEIRA) spectroscopy addresses these limitations by enabling label-free detection of soluble, unmodified analytes via interactions with bioreceptors site-specifically labeled with small infrared-active probes. We present a mid-infrared spectroscopy platform combining a pixeled SEIRA substrate with a distinct azide-based vibrational tag, which offers a sharp signal near 2100 cm^{-1}, in the cell- and protein-silent region, while preserving protein structure and function. As a model, we use a trastuzumab-derived Fab' fragment, chemically modified with azidoacetic acid, and its target Her2 antigen. This system allows us to monitor Fab' immobilization and detect analyte levels as low as 83 attomoles within a 100 νm^2 sensing area. This approach enables highly sensitive molecular detection and offers strong potential for applications in diagnostics, biosensing, and biochemical analysis.