MICRO-BRILLOUIN AND MICRO-RAMAN CORRELATIVE STUDIES FOR STRUCTURAL AND VISCOELASTIC CHARACTERIZATION OF CELLS AND TISSUES

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Brillouin microscopy originates from the hybridization of Brillouin spectroscopy and confocal microscopy. Brillouin spectroscopy is based on light scattering from acoustic waves in the GHz range, providing nondestructive contactless characterization of hardness and viscosity of matter on a micro-scale. Once the micro-light scattering setup is ready, it is tempting to improve it towards a multimodal micro-spectroscopic imaging, adding a Raman spectrometer in parallel to the Brillouin one. Raman spectra originate from the normal modes of molecular vibration and Raman microscopy is capable of label-free chemical characterization of materials. Coupling Raman with Brillouin micro-spectroscopy enables chemical specificity to be assigned to mechanical properties of a sample. The benefit of multimodal imaging is very high in this case, since correlation can be established between visco-elastic and structural or molecular properties of the sample.

In this tutorial we shall discuss the basic principles of light scattering and the optical design of Brillouin and Raman micro-spectrometers [1]. Critical parameters, such as velocity, contrast, spatial and frequency resolution and effect of finite collection angle will be addressed, together with their influence on the characterization of heterogeneous biological samples. Practical examples will be given of 2-D and 3-D mapping, including elaboration of single and multiple spectra.

Finally, examples will be presented of micro-Brillouin and micro-Raman correlative studies applied to biomedical sciences [2] showing the potential of these microscopy and imaging tools in the fields of mechanobiology and clinical diagnostics.

[1] F. Scarponi et al., "High-Performance Versatile Setup for Simultaneous Brillouin- Raman Microspectroscopy", Physical Review X , **7** (3), 031015 (2017)
[2] F. Palombo, D. Fioretto, "Brillouin Light Scattering: Applications in Biomedical Sciences" , http://arxiv.org/abs/1901.05176