Structure and dynamics of multicellular assemblies measured by coherent light scattering

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Multicellular aggregates, or spheroids, represent an interesting model to study tumor response towards external stresses [1]. The question of cell organization and flows inside spheroids revealed to be a challenging topic as usual imaging techniques are limited in terms of penetration length and/or time resolution [2]. To answer this question, we developed a new method based on coherent light scattering:

1. From static light scattering, we deduce the average cells size and spatial organization (spatial auto-correlation).
2. From dynamic light scattering, we deduce cells displacements histogram as a function of time.

This technique gives statistical results over a large field of view, inside spheroids as thick as 400 µm. In comparison to standard microscopy, no dyes are needed and analysis does not require the usual processing (segmentation, tracking,…) which can sometimes lead to biases. Application to the study of osmotic pressure effect on spheroids showed that cells movements are significantly reduced under pressure (fig b,c). This 3D emergent property seems related to the role of extra-cellular matrix.

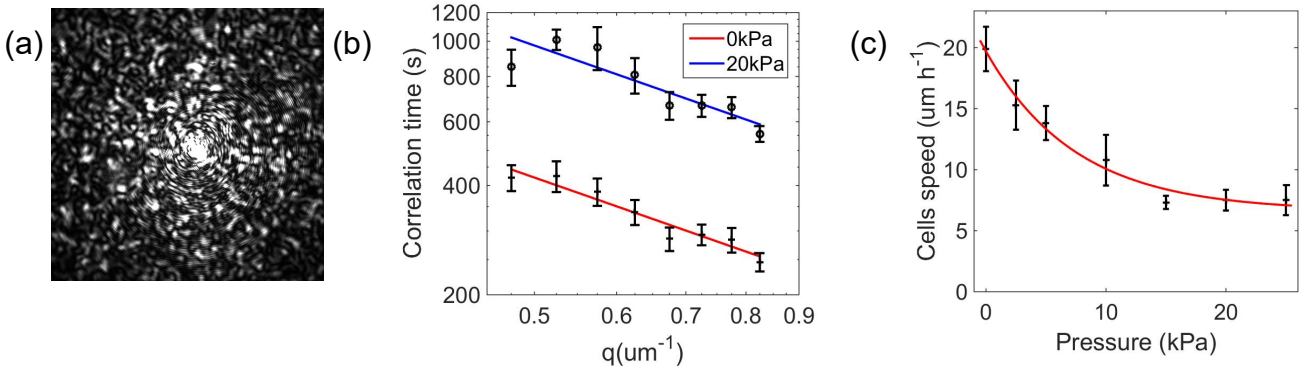

Figure: (a) Picture of a speckle pattern obtained by light scattered through a spheroid. (b) Intensity correlation time as a function of the scattering vector q for a spheroid without pressure (red) and with 20 kPa (blue). (c) Average cells speed as a function of pressure.

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[2] Chen et al., *Crit Rev Biomed Eng.,***41**, 393-403 (2013)