# GENERATION OF CORRELATED DISORDERED POINT PATTERNS FOR THE EXPLORATION OF MESOSCOPIC WAVE TRANSPORT

**LABORATORY :** Institut Lumière Matière

**LEVEL :** M2
**TEAM(S) :** MMCI

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**KEYWORD(S) :** disordered systems / Numerical simulations

## SCIENTIFIC CONTEXT :

The study of wave propagation in disordered media is a transdisciplinary research field that has led to major advances in biomedical imaging, material characterization, geophysics, etc. Waves in particulate media can experience very specific propagation and transport regimes depending on the nature of the particles and, as importantly, their spatial arrangement. Controlling spatial correlations between particles gives the possibility, for instance, to make a turbid material very transparent (stealthy) and/or opaque (band gap) to incident waves at different frequencies. The topic of disorder engineering is nowadays in full swing, especially in optics [1], but so far advances have been hindered by the difficulty to realize 3D materials with finely-controlled microstructure.

## MISSIONS :

The aim of this internship is to develop advanced numerical codes capable of generating a broad panel of disordered point patterns with targeted structural correlations. The point patterns will be used for numerical and experimental studies in the framework of a recently-funded ANR project IDEA ("Disorder engineering in soft matter for acoustics").

While numerical codes already exist for certain families of correlated point patterns (e.g., short-range correlated, liquid-like, patterns based on the Lubachevsky-Stillinger algorithm [2]), a major challenge will be to generate three-dimensional disordered stealthy hyperuniform point patterns, for which no solution currently exists to our knowledge. Stealth hyperuniformity describes a family of patterns for which the static structure factor equals 0 on a range of wavevectors from 0 to a finite value k_c [3].

The candidate should have a keen interest in numerical modelling and a solid background in the physics of complex systems and/or statistical physics. (S)he will be based at Institut Lumière Matière (CNRS & Univ. Lyon 1) in Villeurbanne, close to Lyon.

## OUTLOOKS :

The intern may be invited to apply for a PhD grant, if the internship is successful.

## BIBLIOGRAPHY :

[1] K. Vynck et al., "Light in correlated disordered media", Rev. Mod. Phys. 95, 045003 (2023).
[2] B. D. Lubachevsky and F. H. Stillinger, "Geometric properties of random disk packings", J. Stat. Phys. 60, 561-583 (1990).
[3] S. Torquato, "Hyperuniform states of matter", Phys. Rep. 745, 1-95 (2018).

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