LAGEPP – UMR 5007
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Laboratoire
d'automatique,
de génie des procédés
et de génie pharmaceutique

Ph D proposal:
"Shape optimization and 3D printing to optimize industrial processes"

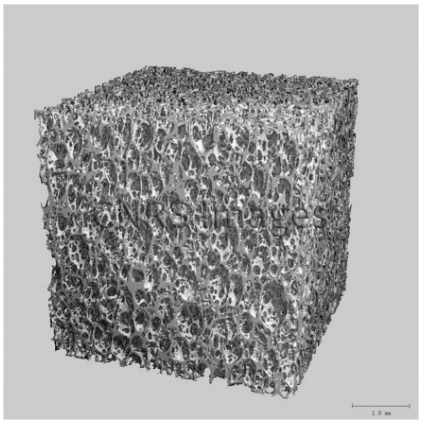
To apply: Send resume and cover letter to vincent.andrieu@univ-lyon1.fr

Location: UCBL1 http://www.univ-lyon1.fr/
Host laboratory: LAGEPP https://lagepp.univ-lyon1.fr/

Supervisor(s): Vincent Andrieu (CNRS researcher), Ulysse Serres (Ass. Prof.), David Edouard (Ass. Prof.)

Scientific Domain: Applied Mathematics (Shape optimization, Variational calculus), Computer sciences (optimization based neural networks), Chemical engineering.

Objective of the internship: What would be the shape of a 3D structure that maximizes the contact surface with a fluid while minimizing pressure drop and ensuring its strength? The objective of this internship is to answer this question through the use of mathematical tools and / or supervised learning tools. This question is interesting since it will have a direct impact in the field of process engineering. Indeed the goal of this project is to design new 3D structures for the intensification of industrial processes. In chemical engineering, the phenomena of material transfer, mixing and/or separation, heat dissipation, etc. are provided by internal packings. In the current socio-economic context, there is a need to develop new structures with optimal transport properties to intensify unit operations keeping in mind ecological constraints [2].



In this aim, 3D printing can bring a real technological breakthrough to design packings with innovative morphologies. For this, this project suggests developing a software based on a shape optimization under constraints to design some packing structures corresponding to a specification defined by industrial problems [3].

Internship program: The trainee will be divided in two steps. At first, the project is about designing new digital shapes from process specification. A discrete and combinatorial approach will be implemented and the resulting shapes will be translated into Gcode language to be implemented on a 3D printer.
In a second step, the trainee will study the associated shape optimization problem. The purpose will be to formulate the problem of shape optimization under constraint.
Finally, these optimal shapes will be tested on real benchmarks available in the lab.

Developed skills: The candidate will work in mathematics, optimization and programming. This internship is at the border between a theoretical subject that could lead to an academic thesis but also close to concrete industrial problems and therefore an asset for a future candidacy in the private sector.

Duration and remuneration: 5 or 6 months with an allowance of (around) 550€ net per month. Has to be made during the year 2022.

Application and waited Profile: This topic is for a candidate with an applied mathematical and computer science profile. Also, the candidate will have the opportunity to talk with researchers in chemical engineering. It is possible to continue these studies in a thesis on a related project.

References:

[1] G. Allaire, *Conception optimale de structures*, *Mathématiques & Applications* vol. 58, Springer-Verlag, Berlin, 2007
[2] J. J. W. Bakker et al *Ind. Eng. Chem. Res, 2007*, *46*, 8574
[3]A . Zenner et al. *Effective heat transfers in packed bed: Experimental and model investigation*
Chemical Engineering Science, 201, 424-436, 2019.