Research Topic 04 for the ParisTech/CSC PhD Program

FOR APPLICATION, PLEASE CONTACT ADVISOR(S) BY EMAIL WITH COPY TO:
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Subfield: (Mech. Eng.)

ParisTech School: ENSAM Angers

Title: Thermal Conductivity of Suspension of Aggregating Nanometric Particles

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Short description of possible research topics for a PhD:

Enhancing thermal conductivity of simple fluids is of major interest in numerous applicative systems. One possibility of enhancing thermal properties consists of dispersing small conductive particles inside. However, in general, aggregation effects occur and then one must address systems composed of dispersed clusters composed of particles as well as the ones related to percolated networks.
This PhD aims to analyze the conductivity enhancement of different microstructures scaling from clusters dispersed into a simple matrix to the ones related to percolated networks exhibiting fractal morphology.
Thus, we try in this work to answer the following fundamental question: to what extent is the organization of the nanoparticles inside nanofluids essential for improving the thermal conductivity of nanofluids?
This question is fundamental in many aspects. We will try in this work to prove that the effect of organization is crucial in the enhancement. In addition, the percolation or not of the particles is determinant for final conductivity. The PdD student must establish a strategy for calculating the heat transfer homogenization based on Fourier's law without taking into account the Brownian induced conductivity and must compare it to the Molecular dynamic conductivity of a suspension.

Required background of the student:

- Engineering Mechanics (Continuum medium) and Heat transfer
- Newton's equations for Molecular Dynamic
- Finite Element discretization
- (Homogenization)

A list of 5 (max.) representative publications of the group: (Related to the research topic)

1. **A. Ammar**, F. Chinesta, R. Heyd. Thermal Conductivity of Suspension of Aggregating Nanometric Rods. Entropy, 19(19), 2017. http://dx.doi.org/10.3390/e19010019
2. **A. Ammar**, M. Magnin, O. Roux, E. Cueto, F. Chinesta. Chemical Master Equation Empirical Moment Closure. Biological Systems, 5(1), 2016. http://dx.doi.org/10.4172/2329-6577.1000155
3. **A. Ammar**. Effect of the inverse Langevin approximation on the solution of the Fokker-Planck equation of non-linear dilute polymer. Journal of Non Newtonian Fluid Mechanics, 231 : 1-5, 2016. http://dx.doi.org/10.1016/j.jnnfm.2016.02.008
4. M. Perez, E. Abisset‐Chavanne, A. Barasinski, F. Chinesta, **A. Ammar**, R. Keunings. On the multi‐scale description of electrical conducting suspensions involving perfectly dispersed rods. Advanced Modeling and Simulation in Engineering Sciences, 2(23), 2015. http://dx.doi.org/10.1186/s40323-015-0044-6
5. M. S. Aghighi, **A. Ammar**, C. Metivier, F. Chinesta. Parametric solution of the Rayleigh-Benard convection model by using the PGD Application to nanofluids. International journal of numerical methods for heat & fluid flow, 25(6), 1252–1281, 2015. http://dx.doi.org/10.1108/HFF-06-2014-0196
6. **A. Ammar**. Lattice Boltzmann Method For Polymer Kinetic Theory. Journal of Non-Newtonian Fluid Mechanics, 165 : 1082-1092, 2010. http://dx.doi.org/10.1016/j.jnnfm.2010.05.006