

## Research Topic for the Arts et Métiers ParisTech -CSC PhD Program

**Subfield:** Mechanical Engineering, Numerical Methods, Applied Mathematics

**ParisTech School:** Arts et Métiers ParisTech

**Title:** Simulation of processes, like laser drilling and cutting, through a new 3D extended meshless approach involving moving interfaces and contact.

**Advisor(s):**

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**Short description of possible research topics for a PhD:**

Despite relevant progress, numerical simulations involving large deformations, multiphysics, contacts (even self-contact) are still a challenge in computational mechanics. This is due to the detection of the boundaries, a purely algorithmic task, as well as the lack of a rigorous description of the interfaces during the whole computation. In fact, both reasons are strongly connected through the numerical strategies used to update and discretize the geometry all along the calculations. The proposed research aims at deriving a consistent framework to describe the interfaces/boundaries and to treat the contact problems within meshless methods based on Natural Neighbor Interpolation. A particular attention will be paid to the computational cost in the different implemented schemes.

The efficiency and the robustness of the developed framework will be mainly tested on laser drilling process and cutting in which residual stresses should be predicted.

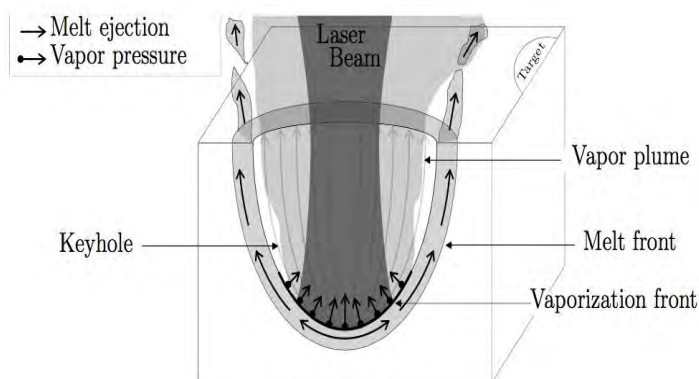


Fig.1: Phenomena in laser drilling (J. Girardot)

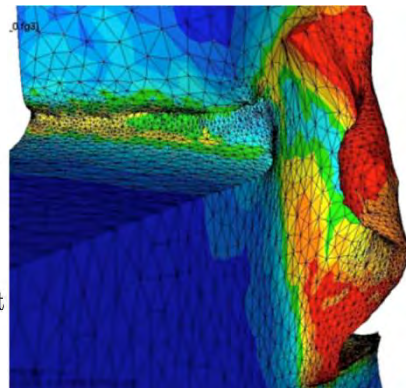


Fig.2: Simulation of cutting process (F.Delalandre)

**Required background of the student:**

The candidate should have a strong background in Mechanical Engineering, Numerical Methods or even Applied Mathematics. Although prior knowledge of the French language is not mandatory, spoken and written English proficiency is needed. A strong interest for computation and programming is expected from the successful candidate.

**4 representative publications of the group:**

J. T. Liu, S. T. Gu, E. Monteiro & Q. C. He. 2014. "A Versatile Interface Model for Thermal Conduction Phenomena and Its Numerical Implementation by XFEM." *Computational Mechanics* 53 (4): 825–43. doi:10.1007/s00466-013-0933-9.  
P. Peyre, L. Berthe, M. Dal, S. Pouzet, P. Sallamand & I. Tomashchuk. 2014. "Generation and Characterization of T40/A5754 Interfaces with Lasers." *Journal of Materials Processing Technology* 214 (9): 1946–53. doi:10.1016/j.jmatprotec.2014.04.019.  
L. Illoul & P. Lorong. 2011. "On Some Aspects of the CNEM Implementation in 3D in Order to Simulate High Speed Machining or Shearing." *Computers & Structures* 89 (11–12): 940–58. doi:10.1016/j.compstruc.2011.01.018.  
J. Girardot, P. Lorong, L. Illoul, N. Ranc, M. Schneider & V. Favier. 2015. "Modeling laser drilling in percussion regime using Constraint Natural Element Method." *Accepted in International Journal of Material Forming*", in press.

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