FOR APPLICATION, PLEASE CONTACT ADVISOR(S) BY EMAIL WITH COPY TO:
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Research Topic for the ParisTech/CSC PhD Program

Fields: Computer science, Information and Communication Sciences and Technologies, Mathematics and their applications, Design & Industrialization.

ParisTech School : Arts et Métiers ParisTech – Campus of Aix-en-Provence

Title : **Deep learning for multimodal segmentation of point clouds for reverse engineering of mechanical assemblies**

Advisor(s):
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Short description of possible research topics for a PhD:

This PhD program addresses the way point clouds generated from low-cost acquisition devices (e.g. Kinect, smartphones, pads) can be efficiently segmented using a deep learning strategy working on multimodal data. Such an approach is particularly interesting for the reverse engineering of mechanical assemblies in augmented reality (e.g. objects recognition or maintenance simulation). The main idea relies on the use of a common space, i.e. 2.5D, to process and analyze multimodal data. The first step (from 3D to 2.5D) relies on the use of a database of parameterized CAD models used to generate a huge set of classified instances for which several RGB-D images are computed. In a second step (training), those images are then used to train a Convolutional Neural Networks (CNN). Once the CNN has been tuned, the third step (recognition) consists in applying the CNN to recognize mechanical components and parts in complex environments represented by 2.5D images. Those 2.5D images can be directly acquired by dedicated acquisition devices (e.g. Kinect, smartphones, pads), or generated from 3D point clouds obtained for instance with a laser scanner. The fourth step (segmentation) allows going back to 3D from the 2.5D images and segment the point clouds. The proposed approach will be implemented and validated on academic as well as on industrial examples.

Required background of the student: Computer science, computer vision, geometric modeling, computer-aided design

A list of 5 (max.) representative publications of the group:
Danglade F., Pernot J-P., Véron P., « On the use of machine learning to defeature CAD models for simulation », Computer-Aided Design and Applications, vol. 11(3), pp. 358-368, 2014.
Danglade F., Pernot J-P., Véron P., Fine L., « A priori evaluation of simulation models preparation processes using artificial intelligence techniques », Computers in Industry, vol. 91, pp. 45-61, 2017.
Panchetti M., Pernot J-P., Véron P., « Towards recovery of complex shapes in meshes using digital images for reverse engineering applications», Computer-Aided Design, vol. 42(8), pp. 693-707, 2010.
Pernot J-P., Giannini F., Petton C., « Thin part identification for CAD model classification », Engineering Computations, vol. 32(1), pp. 62-85, 2015.
Polette A., Meunier J., Mari JL. (2017) « Shape-Curvature-Graph : Towards a New Model of Representation for the Description of 3D Meshes ». In: De Paolis L., Bourdot P., Mongelli A. (eds) Augmented Reality, Virtual Reality, and Computer Graphics. AVR 2017. Lecture Notes in Computer Science, vol 10325. Springer, Cham