

## Research Topic for the ParisTech/CSC PhD Program

*Fields:* 11. Design, Industrialization,  
12. Life Science and Engineering,  
13. Urban planning, Transport

*Subfield:* Product Design, Mechanical Engineering, Design

*Title:* How Bio-Inspired Design can help designers to innovate for the future mobility industry?

*ParisTech School:* Arts et Métiers ParisTech

*Advisor(s) Name:* Pr. Améziane Aoussat, Dr. Nicolas Maranzana

*Advisor(s) Email:* nicolas.maranzana@ensam.eu

*(Lab, website):* Product Design and Innovation Lab (<http://lcp.ensam.eu>)

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

Life on Earth exists for already 3.8 billion years. During this period, evolution, selection, extinction and speciation have allowed life adaptation to our current world. Life is a powerful and infinite source of inspiration.

Bio-inspiration consists in drawing inspiration from the life mechanisms to design technological solutions. In other words, to appreciate the richness of nature to make it a driving force for innovation. Leonardo da Vinci was a pioneer in this field by drawing flying machines inspired by birds. Since then, many inventions have been based on the ingenuity of nature such as Velcro, Shinkansen, and so more.

Bio-inspiration needs a methodological framework to systematize its use, to anchor it as a reliable and reproducible innovation strategy. Methods and tools have to be developed to help and support designers in their activities.

Previous research in our lab formalized a biomimetics unified problem-driven process and provided a classification of available tools (BiomimeTree). It appears that this model is complex and that several of its stages don't have an appropriate tool, which make the process difficult to achieve by a designer. This thesis will therefore focus on removing these brakes and developing specific tools to help designers in this process, particularly in the context of finding innovative and bio-inspired solutions (products / services / organizations) for the mobility of tomorrow in urban areas.

### *Required background of the student:*

Master Degree in Product Design, Mechanical Engineering and/or Design

### *A list of 5 (max) representative publications of the group:*

- Graef, E., **N. Maranzana** and **A. Aoussat** (2018). Role of biologists in biomimetic design processes: preliminary results. International Design Conference (Design'18), Dubrovnik, Croatia.
- Fayemi, P.E., K. Wanieck, C. Zollfrank, **N. Maranzana** and **A. Aoussat** and G. Bersano (2017). Biomimetics: Process, tools and practice. Bioinspiration&Biomimetics, Volume 12, Number 1.
- Wanieck, K., P.E. Fayemi, **N. Maranzana**, C. Zollfrank and S. Jacobs (2017). Biomimetics and its tools. Bioinspired, Biomimetic and Nanobiomaterials, Volume 6, Issue 2, pp. 53-66.
- Fayemi, P.E., T. Chekchak, **N. Maranzana**, **A. Aoussat** and G. Bersano (2015). Modeling biological systems to facilitate their selection during a bio-inspired design process. 20th International Conference on Engineering Design (ICED'15), Milano, Italia.