RESEARCH MASTER INTERNSHIP

Department of Complex Systems Engineering	**Location :** Toulouse, campus SUPAERO
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<u>INTERNSHIP DESCRIPTION</u>

Domain : **APPLIED MATHEMATICS**
Title : **LINEAR TRANSFER LEARNING WITH APPLICATION TO MULTIFIDELITY CALCULUS**

Fields: Statistics, Machine Learning, Multifidelity.

The research will take place within the Applied Mathematics team of the Department of Complex Systems Engineering, (DISC 2) and will benefit from the stimulating environment of ISAE. The student will be welcomed in a research team composed of 7 permanent staff and also will work together with ONERA permanent staff.

A Ph.D. thesis will be available directly after the internship. The net salary will be around 550 Euros per month. Speaking French is not compulsory.

Research activities

Learning to play violin can be seen as a difficult task. However, if one knows how to play guitar or piano, the knowledge already learns on these instruments can be used to make the learning procedure of violin easier. This is the philosophy of transfer learning [1]. In practice, we consider a target task for which we have a sample not large enough to get a satisfying estimation. Moreover, we have one (or more) larger sample of data (call source) which are close to the target task. The present internship aim to investigate the case of a linear link between the target and the source [4,5].

The methods will be implemented for aerospace codes with multi-fidelity characteristics. In such codes, the computational expense and precision grow in tandem with fidelity levels. Multi-fidelity modeling, in this context, facilitates precise estimations of important parameters by harmonizing results from inexpensive, less precise models with a limited number of highly accurate observations. This approach proves especially advantageous when there are strong connections between the low and high-fidelity models, resulting in substantial computational efficiencies compared to relying solely on high-fidelity models [4].

[1] Bozinovski, S & Fulgosi, A (1976) The influence of pattern similarity and transfer learning upon the training of a base perceptron B2. Proceedings of Symposium Informatica, 3-121-5, bled.

[2] Chen, A & Owen, A & Shi, M (2015) Data enriched linear regression, Electronic Journal of Statistics, 9, 1078-1112.

[3] Obst, D. & Ghattas, B & Cugliari, J & Oppenheim, G & Claudel, S & Goude, Y. (2021) Transfer Learning for Linear Regression: a Statistical Test of Gain. Preprint.

[4] Perdikaris, P., Raissi, M., Damianou, A., Lawrence, N. D., & Karniadakis, G. E. (2017). Nonlinear information fusion algorithms for data-efficient multi-fidelity modelling. Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences, 473(2198), 20160751.

Application: please send us by email a curriculum vitae.
Application deadline: end of February 2024
Location: ISAE 1, Campus SUPAERO (Toulouse, France) ;Duration: 5 months, starting March or April, 2024

50 % Theoretical Research	50 % Applied Research	0 % Experimental Research

Possibility to go on a Ph.D.: Yes

APPLICANT PROFILE

Knowledge and required level:

Statistics (Master)

Programing in R or Python.

Applications should be sent by e-mail to the supervisor.