Title:

Advanced methods for solving finite element problems in mechanical engineering.

Key words: Numerical method, Finite element analysis, metamodel,

Profile required:

Good knowledge of computation in structural mechanics and numerical techniques.

Motivated student with good academic performance.

Skills in programming.

Project description

Power of computer allows to simulate complex phenomena in the field of mechanical engineering. Different numerical techniques are available to develop simplifications and reduce the cost, but they introduce different errors.

In this work, we study different parameters of simplified numerical methods to improve the quality of the approximated method. In particular, we are interested in correcting the different errors due to approximations done. The main objective is to develop techniques that improve the computation quality of different metamodels and preserve the computational cost. The results can be useful in different fields of mechanical engineering.

Work plan:

The first part of the thesis work will consist in a bibliography. Then, it will consist in proposing one or more solutions to achieve the objective. Numerical tests will be performed on simple academic examples in order to illustrate the interest of the developed method. When validated, more complex challenging test cases will be carried out.

References:

[1] Y. Wei, Q. Serra, G. Lubineau, E. Florentin. Coupling physics-informed neural networks and constitutive relation error concept to solve a parameter identification problem. Computers and Structures. N°283 (2023)
[2] Y. Wei, F. Vazeille, Q. Serra, E. Florentin. Hybrid Polynomial Chaos Expansion and proper generalized decomposition approach for uncertainty quantification problems in the frame of elasticity. Finite Elements in Analysis and Design n°212 (2022)
[3] E. Florentin, P. Diez. Adaptive reduced basis strategy based on goal oriented error assessment for stochastic problems. Computer Methods in Applied Mechanics and Engineering. n°225-228, pp 116-127 (2012)
[4] P. Ladevèze, E. Florentin. Verification of Stochastic Models in Uncertain Environments Using the Constitutive Relation Error Method. Computer Methods in Applied Mechanics and Engineering n°196, pp 225-234 (2006)