World Academy of Science, Engineering and Technology
International Journal of Marine and Environmental Sciences
Vol:16, No:03, 2022

Infilling Strategies for Surrogate Model Based Multi-disciplinary Analysis and Applications to Velocity Prediction Programs

Authors : Malo Pocheau-Lesteven, Olivier Le Maître

Abstract : Engineering and optimisation of complex systems is often achieved through multi-disciplinary analysis of the system, where each subsystem is modeled and interacts with other subsystems to model the complete system. The coherence of the output of the different sub-systems is achieved through the use of compatibility constraints, which enforce the coupling between the different subsystems. Due to the complexity of some sub-systems and the computational cost of evaluating their respective models, it is often necessary to build surrogate models of these subsystems to allow repeated evaluation these subsystems at a relatively low computational cost. In this paper, gaussian processes are used, as their probabilistic nature is leveraged to evaluate the likelihood of satisfying the compatibility constraints. This paper presents infilling strategies to build accurate surrogate models of the subsystems in areas where they are likely to meet the compatibility constraint. It is shown that these infilling strategies can reduce the computational cost of building surrogate models for a given level of accuracy. An application of these methods to velocity prediction programs used in offshore racing naval architecture further demonstrates these method's applicability in a real engineering context. Also, some examples of the application of uncertainty quantification to field of naval architecture are presented.

Keywords : infilling strategy, gaussian process, multi disciplinary analysis, velocity prediction program
Conference Title : ICCMME 2022 : International Conference on Computational Methods in Marine Engineering
Conference Location : London, United Kingdom
Conference Dates : March 11-12, 2022