A flexible numerical framework for engineering - a Response Surface Modelling application

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This work presents the innovative approach adopted for the development of a new numerical software framework for accelerating Dense Linear Algebra calculations and its application within an engineering context.

In particular, Response Surface Models (RSM) are a key tool to reduce the computational effort involved in engineering design processes like design optimization. However, they may prove themselves to be too expensive when the dimensionality of the system to be modeled is significantly high or when a large number of different Response Surfaces has to be calculated in order to improve the overall accuracy (e.g. like when using Ensemble Modeling techniques).

It is a known challenge that the potential of modern hybrid hardware (e.g. multicore, GPUs) is not exploited by current engineering tools, while they can lead to a significant performance improvement. To fill this gap, a software framework is being developed that enables the acceleration of the linear algebra core of RSMs calculations with a user-friendly syntax that allows good portability between different hardware architectures, with no need of specific expertise in parallel programming and accelerator technology.

The effectiveness of this framework is shown by comparing an accelerated code to a single-core calculation of a Radial Basis Function RSM on some benchmark datasets. This approach is then validated within a real-life engineering application and the achievements are presented and discussed.

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