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Adaptive analysis-aware defeaturing

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Defeaturing consists in simplifying geometrical models by removing the geometrical features that are not relevant for simulation. For instance, in solid mechanics simulations, they can be holes or fillets away from stress concentration regions. Simplifying the geometry of a computer aided design (CAD) model by defeaturing enables more efficient simulations for engineering analysis problems: the resulting mesh is simpler, the computation faster, and less memory storage is needed. However, the effects of defeaturing on the accuracy of the analysis are often neglected: it is a time-consuming task that is often performed manually and based on the expertise of engineers. Understanding well the effects of this process is an important step to be able to adaptively integrate design and analysis for CAD/CAE.

In this talk, we will formalize the process of defeaturing by understanding its effect on the solution of a given partial differential equation defined on the geometrical model of interest. More specifically, we have developed a reliable and efficient *a posteriori* estimator of the energy error between the solutions of the exact and the defeatured geometries, that allows us to control the error made by adding or removing geometrical features. To this estimator, we have also integrated the numerical error due to the numerical approximation of the problem at hand when using hierarchical B-spline based isogeometric analysis on trimmed geometries.

The dependence of the estimator upon the size of the features and of the mesh elements is explicit, and the effectivity index is independent from the number of features considered. The estimator can be computed very efficiently, and it is naturally parallelizable with respect to the number of features. Thanks to the estimator, one can thus drive a strategy that adaptively determines the mesh elements to refine, and that adaptively chooses the features that are needed in the geometrical model, in order to achieve a certain precision.

REFERENCES

[1] A. Buffa, O. Chanon and R. Vázquez, Analysis-aware defeaturing: problem setting and a posteriori estimation, *Math. Models Methods Appl. Sci.* (to appear), 2022. *arXiv:2007.11525*, 2021.

[2] A. Buffa, O. Chanon and R. Vázquez, Adaptive analysis-aware defeaturing, *in preparation.*