

Massively efficient filter for topology optimization based on the splitting of tensor product structure

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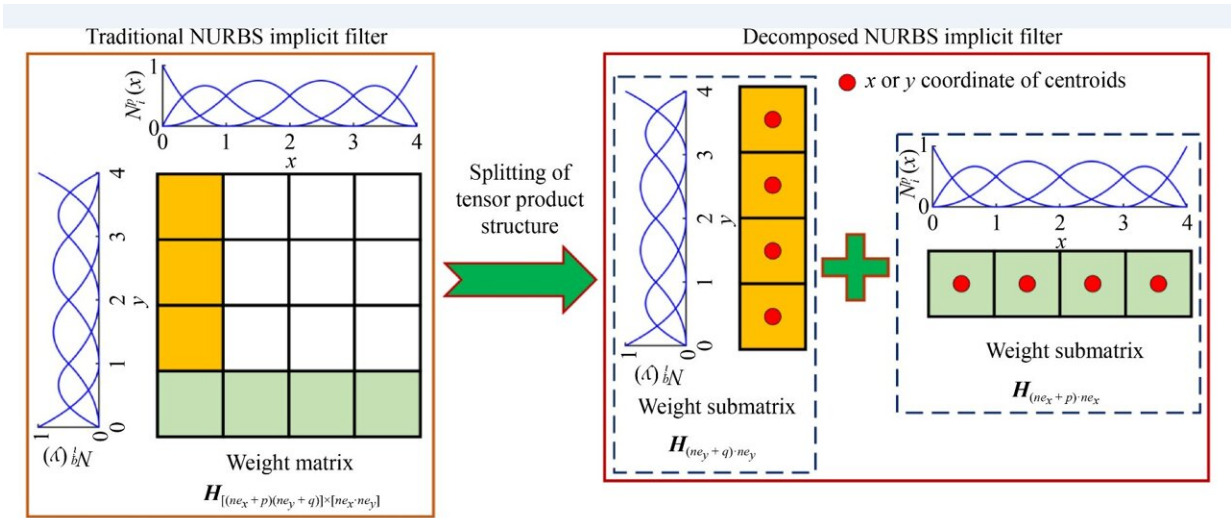


Illustration of the decomposition of the weight matrix into two weight submatrices for B-splines implicit filter. Credit: Higher Education Press Limited Company

Recently, a research group lead by Prof. Shuting Wang from topology optimization of Huazhong University of Science and Technology has put forward a massively efficient filter utilizing the splitting of the tensor product structure. This study can be found in the journal *Frontiers of Mechanical Engineering*.

With the aid of splitting technique, the traditional weight matrices of both B-splines and non-uniform rational B-splines implicit filters are equivalently decomposed into two or three submatrices, by which the sensitivity analysis is reformulated for the nodal [design](#) variables without altering the [optimization](#) process.

"Afterwards, we establish an explicit sensitivity filter in terms of the tensor product of the axial distances between adjacent elements centroids, which is decomposed by the splitting pipeline as that applied to implicit filter, and the corresponding sensitivity analysis is derived for elemental design variables," said by Dr. Aodi Yang, the author of this study.

According to the numerical results, compared to the traditional filter, the average updating time for design variables is accelerated by two orders of magnitude for the decomposed filter. Besides, both memory burden and computing time of weight matrix are decreased by six and three orders of magnitude for the decomposed filter.

The research team of Prof. Shuting Wang is one of the outstanding teams in topology optimization in China. This team has been devoted to topology optimization research for more than ten years.

"In the future, the combination of the proposed decomposed filter with the geometric reconstruction-based IGA method will extend the IGA-based [topology](#) optimization method into the design problems with complex CAD models," said Dr. Xie.

More information: Aodi Yang et al, Massively efficient filter for topology optimization based on the splitting of tensor product structure, *Frontiers of Mechanical Engineering* (2023). [DOI: 10.1007/s11465-022-0710-6](#)

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