Dear Editor,

This letter is to accompany the submission of our manuscript for ***Archives of Mechanics***. The manuscript is entitled “n-sided polygonal hybrid finite elements involving element boundary integrals only for anisotropic thermal analysis” by Ruifeng Cao, Xinjuan Zhao, Wanqing lin, and Hui Wang, which we would like to be considered for publication as a full length article in the journal.

In this manuscript, the n-sided polygonal hybrid finite element method with fundamental solution kernels, named as HFS-FEM, is thoroughly studied for two-dimensional heat conduction in fully anisotropic media. This approach can be viewed as a rational combination of the traditional finite element method (FEM) and boundary element method (BEM) by keeping the features of element discretization of computing domain in FEM and dimension-reduced element boundary integrals in BEM. In this approach, the unknown temperature field within the polygon is represented by the linear combination of fundamental solution of anisotropic problem to achieve the local satisfaction of the governing equations of problem, but not the specific boundary conditions and the continuity conditions across the element boundary. To tackle such shortcoming, a frame temperature field is independently defined on the entire boundary of polygonal element by means of the conventional shape function interpolation. Subsequently, by the hybrid functional with the assumed intra- and inter-element temperature fields, the stiffness equation can be obtained including the line integrals along the element boundary only, whose dimension is reduced by one compared to the domain integrals in the traditional finite elements. This means that the higher computing efficiency is expected. Moreover, any shaped polygonal elements can be constructed in a unified form with same kernels, including convex and non-convex polygonal elements, to provide greater flexibility in meshing effort for complex geometries. Besides, the element boundary integrals endow the method higher versatility with non-conforming mesh in the pre-processing stage of the analysis over the traditional FEM. No any modification to the HFS-FEM formulation is needed for the non-conforming mesh and the element containing hanging nodes is treated normally as the one with more nodes. Finally, the accuracy, convergence, computing efficiency, stability of non-convex element, and straightforward treatment of non-conforming discretization are discussed for the present n-sided polygonal hybrid finite elements by a few applications in the context of anisotropic heat conduction.

The highlights of the paper include:

- The HFS-FEM with polygon discretization is successfully developed for two-dimensional anisotropic heat conduction
- Only element boundary integrals are involved in the computation
- Compared to the conventional FEM, the HFS-FEM has higher accuracy for heat flux simulation
- Both the quadrilateral and polygonal hybrid elements exhibit greater computing efficiency over the conventional finite element
- The method shows certain insensitivity to non-convex mesh
- The method exhibits great capability to exploit non-conforming mesh to reduce remeshing effort, which is typically important for crack propagation

We believe that the results and main conclusion of our manuscript meet the journal’s aims and scope, and we hope that you will agree with us as to the value of our research contribution and send the manuscript out for peer review.

We respectfully thank you for the consideration of this manuscript.

Yours sincerely,

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