Shape optimization of holes attached to curved surfaces

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Abstract:
In traditional shape optimization, 2D planar curves and 3D free surfaces are always involved. However, shape optimization of holes attached to curved surface is hardly found in existing literature. This problem is actually a shape constrained optimization design with the hole boundary curve located on the prescribed surface all along the optimization process. To solve this problem, the authors proposed a new parametrical mapping method (PMM) with shape design variables defined on the reference domain of the parametrical plane. FE grids of the curved surface are generated by remapping the planar grids back from the parametrical plane. In this way, the hole boundary curve is guaranteed to be attached to the considered curve surface.

When shape of the curved surface is also designable, the PMM is generalized to simultaneous optimization including both the hole and the surface. Two design spaces are involved herein to define shape design variables with the hole design variables on the parametrical coordinate system and surface design variables on the spatial coordinate system. A moving bound strategy is used on one hand to ensure the mesh quality of the changeable curved surface and on the other hand to adjust the hole automatically inside the design domain. Representative examples are employed to validate the effectiveness of the proposed method.

Acknowledgement: This work was supported by the National Natural Science Foundation of China (E050601), the Research Fund for the Doctoral Program of Higher Education of China (20126102130003) and 111 project (B07050).