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Texture Shape Optimization for Minimization of Friction Coefficient (Comparison of Shape Optimization Results for Circular and Herringbone Textures)

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In this study, we present numerical results of the texture shape optimization analysis for minimization of frictional force (cf. [1], [2].). The Reynolds equation is introduced as the governing equation, and is discretized in space by the finite element method. The performance function is defined by the frictional force. Also, the purpose of this study is to find the distribution of oil film thickness in the textured area, i.e., the design variables, so as to minimize the performance function. Here, it is necessary to consider the governing equations as constraints on the performance function. Therefore, the adjoint variable method is introduced to derive the Lagrange function. In order to obtain the stationary condition for the Lagrange function, the first variation of the Lagrange function is calculated. Finally, the gradient of the Lagrange function with respect to the design variable is obtained, and the iterative computation is performed to obtain the optimal solution for the design variable. In this study, we perform shape optimization analysis for the circular texture and the herringbone texture models, and present some numerical results (See Fig.1.).

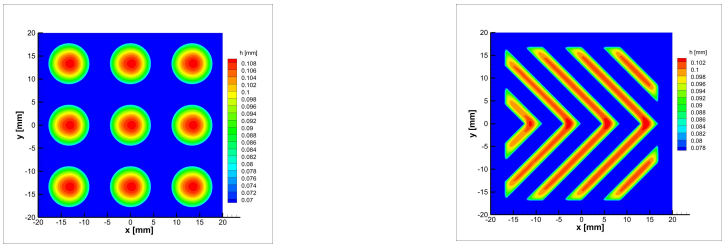

Fig.1 Comparison of optimal oil film thickness at texture parts in case of circular and herringbone textures

REFERENCES

[1] Tu Zhirong, Meng Xiangkai, Ma Yi, Peng Xudong, Shape optimization of hydrodynamic textured surfaces for enhancing load-carrying capacity based on level set method. *Tribology International.*, Vol. **162**, pp. 107–136, 2021.

[2] S.Sasaoka and T.Kurahashi, Proposal of texture shape optimization algorithm under constant load condition and consideration on new shape update equation (texture shape optimization for minimization of friction coefficient). *Journal of Fluid Science and Technology.*, Vol. **15**, No.3, pp. 1–20, 2020.