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Magnetic Torque Maximization in a Camera Shutter Module by the Topology Optimization

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In recent years, there is a stronger demand for weight reduction of various components in portable devices such as mobile phones. This work is motivated by the need for the weight reduction of a camera shutter module in such a device without the torque generated by its magnetic circuit much reduced. To see effects of the used mass on the torque magnitude, the weight reduction problem is alternatively formulated as a torque maximization problem under various mass constraints. The magnetic torque is known to affect most significantly camera shutter speed. The maximization problem is solved in a topology optimization setting and optimal shapes of a yoke (and a magnet) in the magnetic circuit for different mass constraint ratios are found. For design optimization, a magnetic circuit of a shutter device illustrated in Fig. 1 is considered where the region occupied by the yoke (and the magnet) is regarded as a design domain. In employing the topology optimization method [1], the average magnetic torque over the whole range of a rotation angle of the magnet corresponding to a shutter opening angle is maximized. The torque is calculated by employing the modified Maxwell stress tensor method [2]. Some of the optimized results are compared in Fig. 2 with the nominal results. Figure 2 clearly shows that the optimized magnetic circuits found through the present investigation outperform the nominal circuits for the same yoke mass constraints.

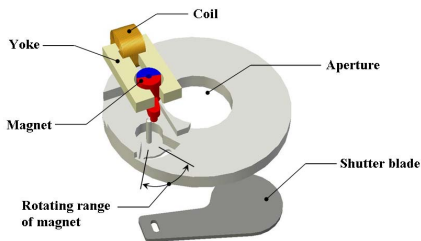


Fig. 1. Schematics of a camera shutter device.

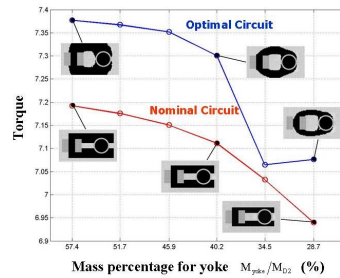


Fig. 2. Comparison of the magnetic torque by the optimized and the nominal circuits.

REFERENCES

- [1] J. Yoo, J. Appl. Mech., 49, pp. 380-387 (2005).
- [2] L. Chang *et al.*, Proc. of IEEE IAS Annual Meeting, 1, pp. 69-73 (1989).

AQ05

