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Optimal design of solenoid valve to minimize cavitation by numerical analysis SEUNGBIN KO, ILHOON JANG, SIMON SONG, Hanyang University — Keeping pace with the development of clean energy, hybrid cars and electric vehicles are getting extensive attention recently. In an electronic-control brake system which is essential to those vehicles, a solenoid valve is used to control external hydraulic pressure that boosts up the driver's braking force. However, strong cavitation occurs at the narrow passage between the ball and seat of a solenoid valve due to sudden decrease in pressure, leading to severe damage to the valve. In this study, we investigate the cavitation numerically to discover geometric parameters to affect the cavitation, and an optimal design to minimize the cavitation using optimization technique. As a result, we found four parameters: seat inner radius, seat angle, seat length, and ball radius. Among them, the seat inner radius affects the cavitation most. Also, we found that preventing a sudden reduction in a flow passage is important to reduce cavitation. Finally using an evolutionary algorithm for optimization we minimized cavitation. The optimal design resulted in the maximum vapor volume of fraction of 0.04 while it was 0.7 for reference geometry.

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