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Design of brake pads using a shape optimization for reducing uneven wear

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The brake pads play a role in reducing the vehicle's velocity through frictional contact with a rotating disc. At this time, non-uniform contact pressure distribution is formed at the leading surface of the brake pad's friction area. The non-uniform contact pressure distribution of the brake pads causes uneven wear of the brake pad. Therefore, the purpose of this study is to propose a design of a shape optimization method that minimizes the non-uniform contact pressure distribution. A phenomenon of the brake pad's non-uniform contact pressure distribution was implemented from a coupled thermal-mechanical analysis using the finite element analysis model. Design variables and constraints were selected for shape optimization. The objective function is a quadratic regression model function that minimizes the non-uniform contact pressure distribution. The optimum value and the quadratic regression model function were verified through the analysis of variance table. Also, by using the verified quadratic regression model function, the non-uniform contact pressure distribution can be easily predicted by substituting design variable values without the coupled thermal-mechanical analysis. The amount of wear on the brake pads can be measured through brake dynamometer test. As a result of the test, the amount of wear at the leading surface of the friction area was high. Also, the uneven wear of the shape optimized pad was less than that of the original pad. In conclusion, the non-uniform contact pressure distribution of the brake pad was realized through the coupled thermal-mechanical analysis. The shape optimization was performed by deriving the quadratic regression model function which is the objective function using the analysis results. Finally, the reduction of the brake pad's uneven wear was confirmed through the test.

Biography

Taewon Park has expertise in analyzing mechanical system using computer aided design and simulation. He has developed a lot of multi-body dynamics (MBD) programs based on rigid dynamics and flexible dynamics theories. The MBD program proposes an analytical model that can predict the dynamic behavior of the system without making actual systems, which is of great significance in analyzing and evaluating the mechanical systems. Also, he proposed improved performance system based on optimization design and control design about analytical model.

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