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A Study on Optimal Operating Force of Automotive Moving Parts Based on Muscle Activation and User Perceived Effort

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This study aims to propose an ergonomic guideline for optimal operating force in automotive moving parts specifically doors and tailgates by analyzing both the user's physical load and subjective perception of discomfort. Unlike traditional design approaches that rely on benchmarking competitor models or addressing customer complaints, this research adopts a human-centered perspective by quantifying upper-body muscle activation using surface electromyography (EMG) and evaluating user-perceived discomfort during opening and closing operations. The results demonstrate that as operating force increases, both muscle activation and perceived discomfort rise correspondingly. Based on these findings, optimal operating force guidelines were established to satisfy two critical criteria: acceptable levels of muscle activation and minimal user discomfort. The threshold for muscle activation was determined with reference to prior ergonomic research, defining an upper limit that permits physical effort without inducing excessive fatigue. The resulting guidelines provide a quantitative reference for automotive engineers, offering a foundation for designing user-friendly moving parts. Ultimately, this study is expected to contribute to more ergonomically optimized and user-centered vehicle development.

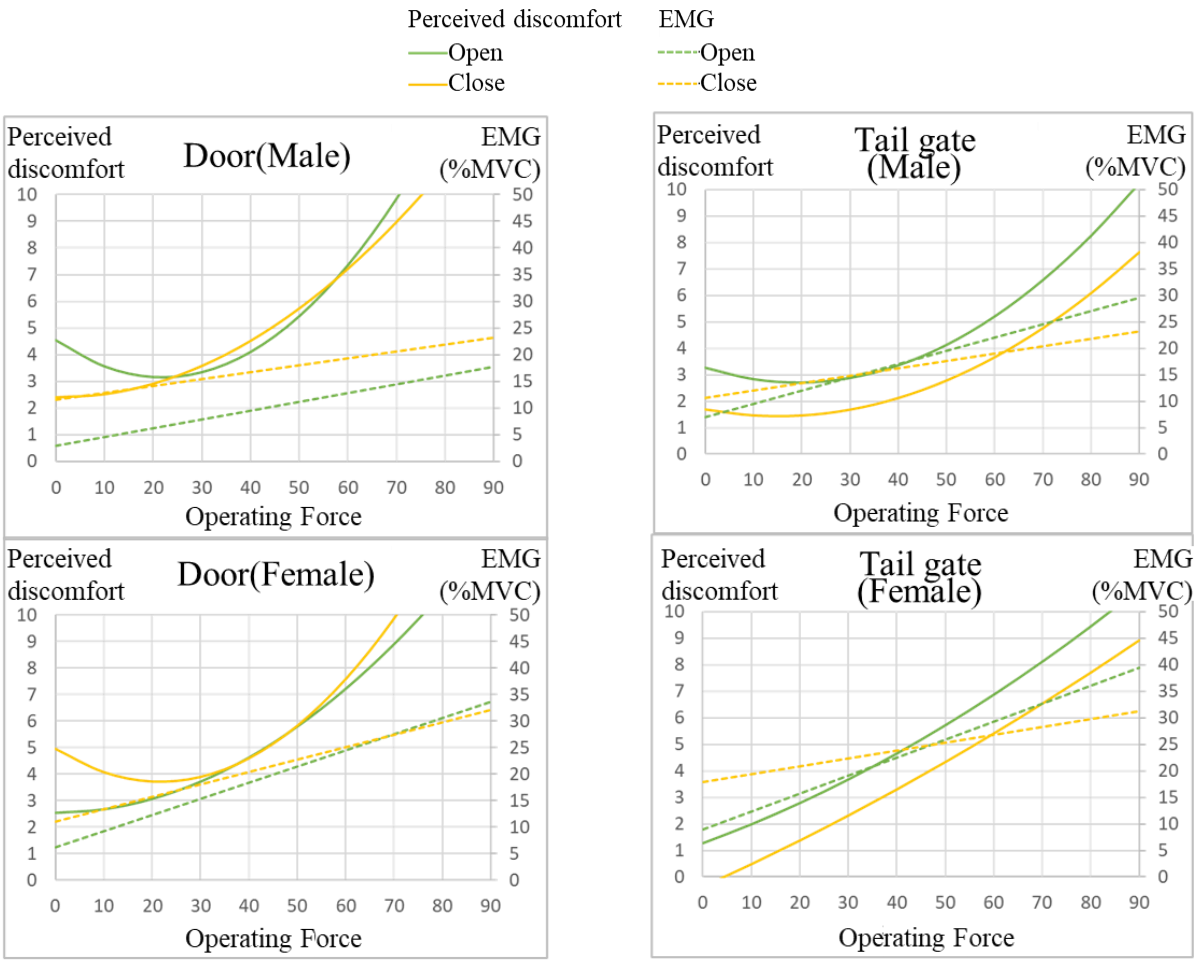

Fig.1 Relationship between perceived operational discomfort and EMG(%MVC)