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Motor Output Structure in Targeted Aiming: A Mechanistic Model

Dale Lewis
Cleveland State University

Roger Young
Cleveland State University

Jeffrey Eder
Cleveland State University

Andrew B, Slifkin
Cleveland State University, A.SLIFKIN@csuohio.edu

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College of Sciences and Health Professions

Student Researchers: Dale Lewis, Roger Young, and Jeffrey Eder

Faculty Advisor: Andrew Slifkin

Abstract

Studies using a variety of experimental tasks have established that when humans repeatedly produce an action, fluctuations in action output are highest at the lowest frequencies and fluctuation magnitude (power) systematically declines as frequency increases. Such time series structure is termed *pink noise*. However, the appearance of pink noise seems to be limited to tasks where action is executed in the *absence* of task-related feedback. A few studies have demonstrated that when action was executed in the *presence* of task-related feedback, power was evenly distributed across all spectral frequencies—i.e., *white noise* was revealed. Here, participants produced cyclical aiming movements under visual feedback conditions and we sought to determine whether variations of both the movement amplitude requirement (A) and the target width (W)—in the form of the index of difficulty [ID = $\log2(2A/W)$]—would predict the structure of movement amplitude (MA) time series. There were five ID levels, and there was a small-, medium-, and large-scale version of each ID: The A and W values doubled with each increment in scale level. Given that increases in ID are known to induce increased reliance on the available visual feedback, we predicted an ID-induced shift in MA time series structure from pink to white noise, with no change in MA structure across scale levels.