Dear Scientific Reports Editorial Board,

Please find attached the manuscript "Component response rate variation underlies the stability of complex systems", which I hope you will consider for publication as an Article.

Complex systems theory has widespread applications across the natural and social sciences. Discovering universal principles that underpin stability in complex systems is therefore of broad interest and importance. In 1972, Robert May first showed that the probability of a system being stable decreases as its complexity increases, and May identified a threshold value of complexity above which the probability of stability is negligible. In the attached manuscript, I investigate a yet unconsidered, but likely ubiquitous, property of all complex systems. I show that when individual components of a complex system respond to system perturbation at different rates, the potential for stability is increased well above May's threshold. This result is surprising because variation in component response rate necessarily increases variation in the strength of interactions among system components, which by itself is destabilising. Additionally, using a genetic algorithm, I show that the probability of system stability can be increased up to four orders of magnitude for highly complex systems given a targetted manipulation of component response rates. This result shows that stability of complex systems can potentially be facilitated solely by manipulating the response rates of individual system components.

Consistent with the general scope of Scientific Reports, my manuscript addresses a question relevant across the physical, life, and social sciences, and the insights of my manuscript are significant for understanding complex systems across all scales (e.g., gene-regulatory, biochemical, neurological, ecological, and social-ecological networks). This manuscript drives future research forward by predicting how variation in the dynamics of individual system components affects stability at the broader scale of a complex system. It will inspire future theoretical and empirical studies to consider such variation when investigating complex systems.

This manuscript includes an abstract of 143 words and main text of 2993 words (excluding figure legends, acknowledgements, and references). It also includes 4 figures, 0 tables, and 23 references. Supporting results are included in Supplementary Information. I certify that this manuscript is original work and not under review at any other journal or book; a pre-print version of this manuscript is available on arXiv (http://arxiv.org/abs/1806.01029).

In the interest of transparency, the entire history of this project is published on GitHub (https://github.com/bradduthie/RandomMatrixStability), and I have also included reviewer comments from a previous submission and my detailed responses to these comments.

Sincerely,

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