

Dear Nature Editorial Board,

Please find attached the manuscript "Component response rate variation drives stability in large complex systems", which I hope you will consider for publication as Letter in Nature.

Complex systems theory has widespread applications across the physical, life, 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 that a system is 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 targeted manipulation of component response rates. This result shows that stability of complex systems, including physical, financial, or social-ecological networks, can potentially be facilitated solely by manipulating the response rates of individual system components.

I recommend the following individuals as potential referees (listed alphabetically):

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This manuscript includes an abstract of 225 words and main text of 1453 words (excluding figure legends, acknowledgements, and references). It also includes 3 figures, 0 tables, and 20 references. Supporting results and code 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>).

Sincerely,

A. Bradley Duthie