EVENT ABSTRACT

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Does human balance behaviour reflect self-organized critical adaptive control?

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When humans perform closed loop control tasks like in upright standing or while balancing a stick, their behaviour exhibits non-Gaussian fluctuations with long-tailed distributions. The origin of these fluctuations is not known. We investigated if they are caused by self-organized critical noise amplification which emerges in control systems when an unstable dynamics becomes stabilized by an adaptive controller that has finite memory. Starting from this theory, we developed a realistic model of adaptive closed loop control by including constraints on memory and delays. To test this model, we performed psychophysical experiments where humans balanced an unstable target on a screen. It turned out, that the model reproduces the long tails of the distributions together with other characteristic features of the human control dynamics. Fine-tuning the model to match the experimental dynamics identifies parameters characterizing a subject's control system which can be independently tested. Our results suggest that the nervous system involved in closed loop motor control nearly optimally estimates system parameters on-line from very short epochs of past observations.

Conference: Bernstein Symposium 2008, Munich, Germany, 8 Oct - 10 Oct, 2008.

Presentation Type: Oral Presentation

Topic: All Abstracts

Citation: Pawelzik KR (2008). Does human balance behaviour reflect self-organized critical adaptive control?. *Front. Comput. Neurosci. Conference Abstract: Bernstein Symposium 2008.* doi: 10.3389/conf.neuro.10.2008.01.012

Received: 11 Nov 2008; **Published Online:** 11 Nov 2008.

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