## Mechanical Engineering Seminar Series

# State-Space Characterization of Balance Capabilities in Biped Systems

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SPECIAL TIME 2:00 p.m.

ME Seminar Zoom link (QR Code below)

Password 5777



### Abstract

The human ability of keeping balance during various locomotion tasks is attributed to our capability of withstanding complex interactions with the environment and coordinating whole-body movements. Despite this, several stability analysis methods are limited by the use of overly simplified biped and foot structures and corresponding contact models. I will present a methodology for the characterization of the balance capabilities of general biped models (from reduced-order to whole-body) with flat or segmented feet models. Limits of dynamic balance are evaluated by the Boundary of Balance (BoB) and the associated novel balance indicators, both formulated in the Center of Mass (COM) state space. The BoB is numerically constructed as the set of maximum allowable COM perturbations that the biped can sustain along a prescribed direction. The state-space evaluation of the BoB and associated balance indicators allows for a direct comparison between the proposed balance benchmark and existing stability criteria based on reduced-order models (e.g., Linear Inverted Pendulum (LIP)) and their associated stability metrics (e.g., Margin of Stability (MOS)). The proposed characterization of balance capabilities provides an important benchmarking framework for the stability of general biped/foot systems.

### Bio

Carlotta Mummolo is an Assistant Professor in the Department of Biomedical Engineering at NJIT. In January 2016 she received two doctoral degrees in Mechanical Engineering through a joint Ph.D. program between the Polytechnic of Bari (Italy) and NYU (US). At NJIT, Carlotta directs the Coppélia Research Lab in the Department of Biomedical Engineering, where a diverse team of students and researchers studies the behavior and performance of motor skills in biological and robotic systems, with applications in the field of motor rehabilitation. She is a member of ASME, ASEE, IEEE Robotics and Automation Society, New York Academy of Science, and Society of Women Engineers and her work has been published in several peer-reviewed journals and conference proceedings.

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