

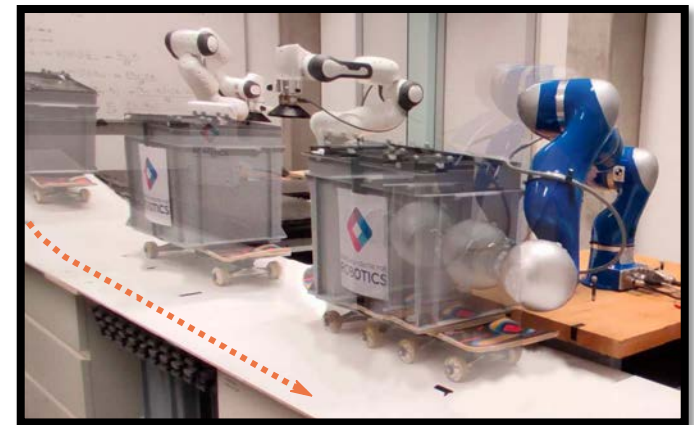
# Multi-mode Trajectory Optimization for Impact-aware Manipulation

Theodoros Stouraitis<sup>\*,1,2</sup>, Lei Yan<sup>\*,1,3</sup>, João Moura<sup>1</sup>,  
Michael Gienger<sup>2</sup> and Sethu Vijayakumar<sup>1</sup>

<sup>1</sup>The University of Edinburgh, UK <sup>2</sup>Honda Research Institute Europe, Germany

<sup>3</sup>Shenzhen Institute of Artificial Intelligence and Robotics for Society, China

- Propose a Multi-mode Trajectory Optimization method combining **hybrid dynamics** and **hybrid control** in a coherent fashion.
- Introduce an impact model for planning **smooth contact transitions** with low interaction forces for **impact-aware manipulation** tasks.
- Our method simultaneously optimizes **multi-contact** motions, contact timings and forces, and **stiffness profiles**.



KUKA robot halting a 20 kg box moving at 0.88 m/s.