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Metrization, Simulation, and First–Order Approximation for Networked CPS

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Nonclassical dynamics in CPS

Arises from abrupt physical and logical transitions

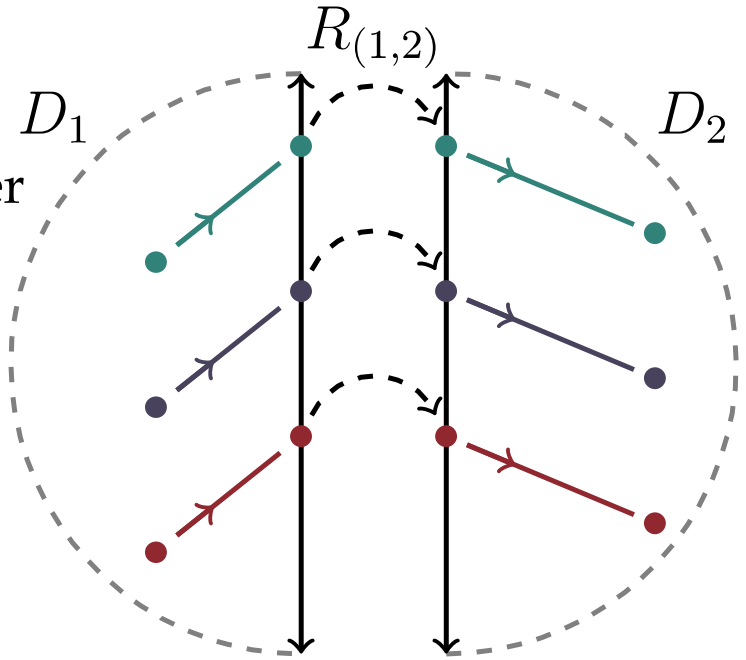
Nonsmooth and discontinuous transitions:

- Voltage and current limits in electrical power transmission systems.

- Topology switches and shocks in water and electrical infrastructures.

- Queue saturation in air and street traffic.

- Mode transition in supervisory control.



Isolated transitions can be "smoothed" (arXiv:1308.4158) enables direct generalization of classical control techniques to *hybrid* systems.

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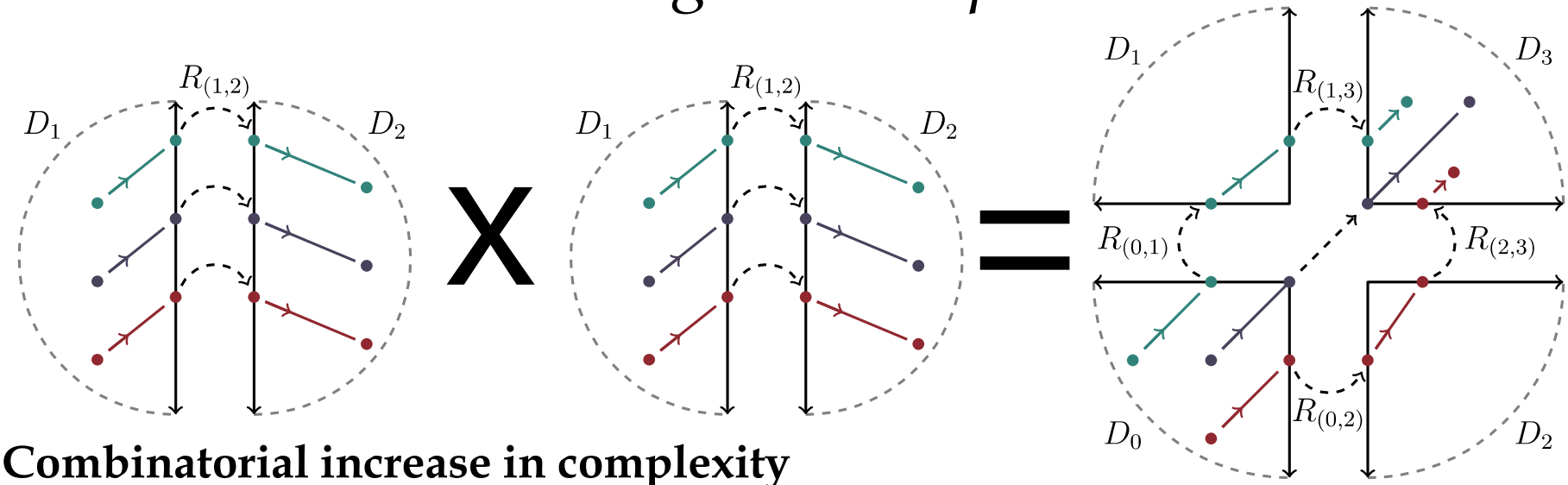
New challenges for interconnected CPS

Networked CPS undergo interdependent transitions



Combinatorial increase in complexity
Exponential number of discrete modes; factorial number of mode sequences

Intrinsically nonsmooth dynamics
In contrast to previous case, coupled dynamics cannot be "smoothed"

New challenges require new tools
We derive techniques for stability, sensitivity, controllability, & optimality.

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