



CPS: Small: Cyber-Physical Phases of Mixed Traffic with Modular & Autonomous Vehicles: Dynamics, Impacts and Management

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Challenge:

- Lack of *theoretical models and field experiments* for joint cyber, physical and behavioral features.
- Limited knowledge on the *relationships* between emerging cyber-physical constraints and traffic flow characteristics.
- Difficult to construct *appropriate measures* to mitigate the adverse impacts from cyber-physical constraints in a cyber-physical multi-phase system.

Solution:

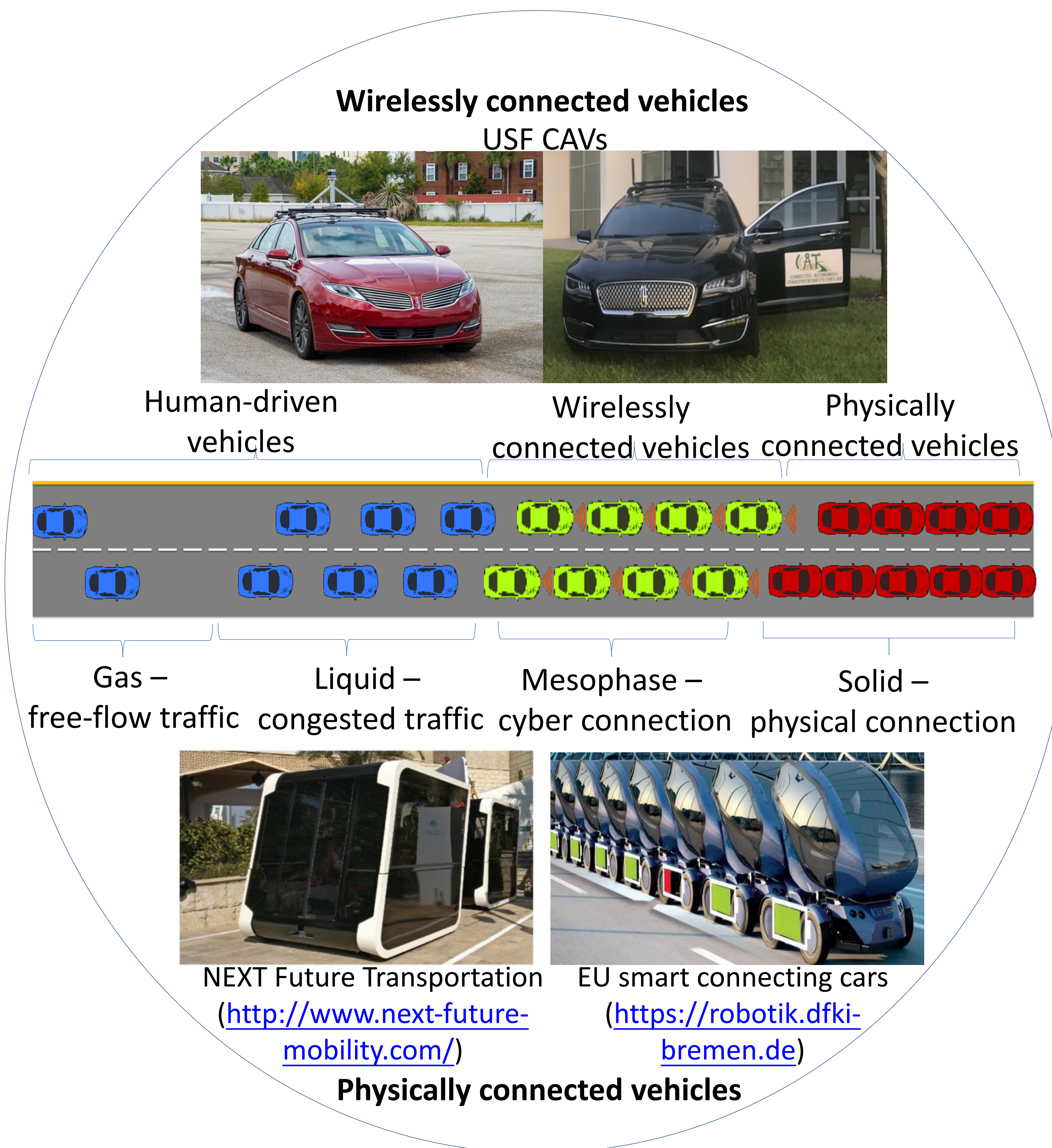
- Performance upper bound theory
 - New triangular fundamental diagram
 - Phase diagram
- System compromise
 - Empirical analysis with simulated and filed data
- Compensation management measures
 - Docking/platooning operation
 - Split operation
- Evaluation/experimentation plan
 - Scaled robot car testbed
 - Full-scale CAV testbed

Scientific Impact:

- Provide *theoretical insights* into a cyber-physical multi-phase system with cyber-physical constraints.
- Provide *operational concepts* on a cyber-physical multi-phase system with multi-scale CAV testbeds.
- Facilitate *understanding and managing other systems* that have different phases due to cyber-physical connections of elements.

Broader Impact:

- Collaborate with *industry partners* to help boost future technology transfers on advance vehicle technologies and management measures.
- Help *transportation stakeholders* understand feasibility and benefits of studying new cyber-physical phases in traffic to incorporate it in their future planning.
- Create various *education and outreach materials* to teach K-12 and university students including underrepresented groups.



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