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

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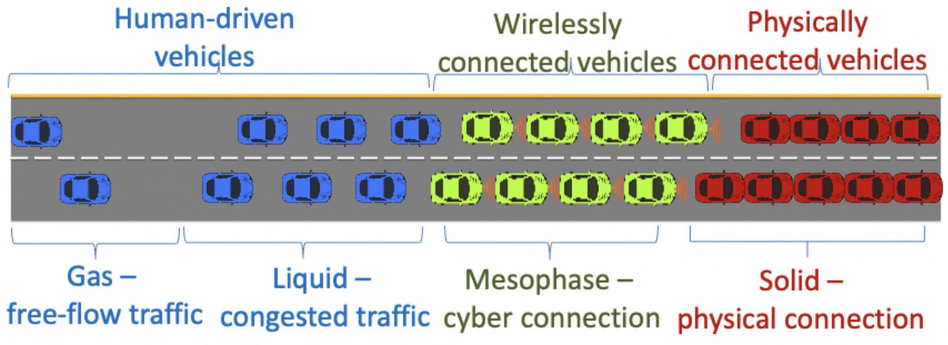
Wirelessly connected vehicles

Illustration of different phases of highway traffic



Challenge:

- Lack of *theoretical models and field experiments* for mixed traffic involving connected, automated and modular vehicles.
- Limited knowledge on the *relationships* between emerging cyber-physical onstraints and traffic flow characteristics.
- Difficult to construct *appropriate measures* to mitigate the adverse impacts.

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.

Solution:

- Theoretical bounds
  - New fundamental diagram
  - Phase diagram
  - Split operation and trajectory optimization framework
- Compensation management measures
  - Docking/platooning operation
- System compromise
  - Empirical analysis with simulated and filed data
- Evaluation/experimentation plan
  - Scaled robot car testbed
  - Full-scale CAV testbed

Broader Impact:

- Collaborate with *industry partners* to help boost future technology transfers on advance vehicle technologies and management measures.
- Create *various education and outreach materials* to teach K-12 and university students including underrepresented groups.
- Establish *modular vehicles operation approach* to expedite the efficiency of state-of-the-art solver about 54%.

CONNECTED & AUTONOMOUS TRANSPORTATION SYSTEMS

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