

CPS: Medium: Collaborative Research: Automated Discovery of Data Validity for Safety-Critical Feedback Control in a Population of Connected Vehicles

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Challenge:

In V2x systems, databases operate in feedback loops and can enter “locked-up” conditions.

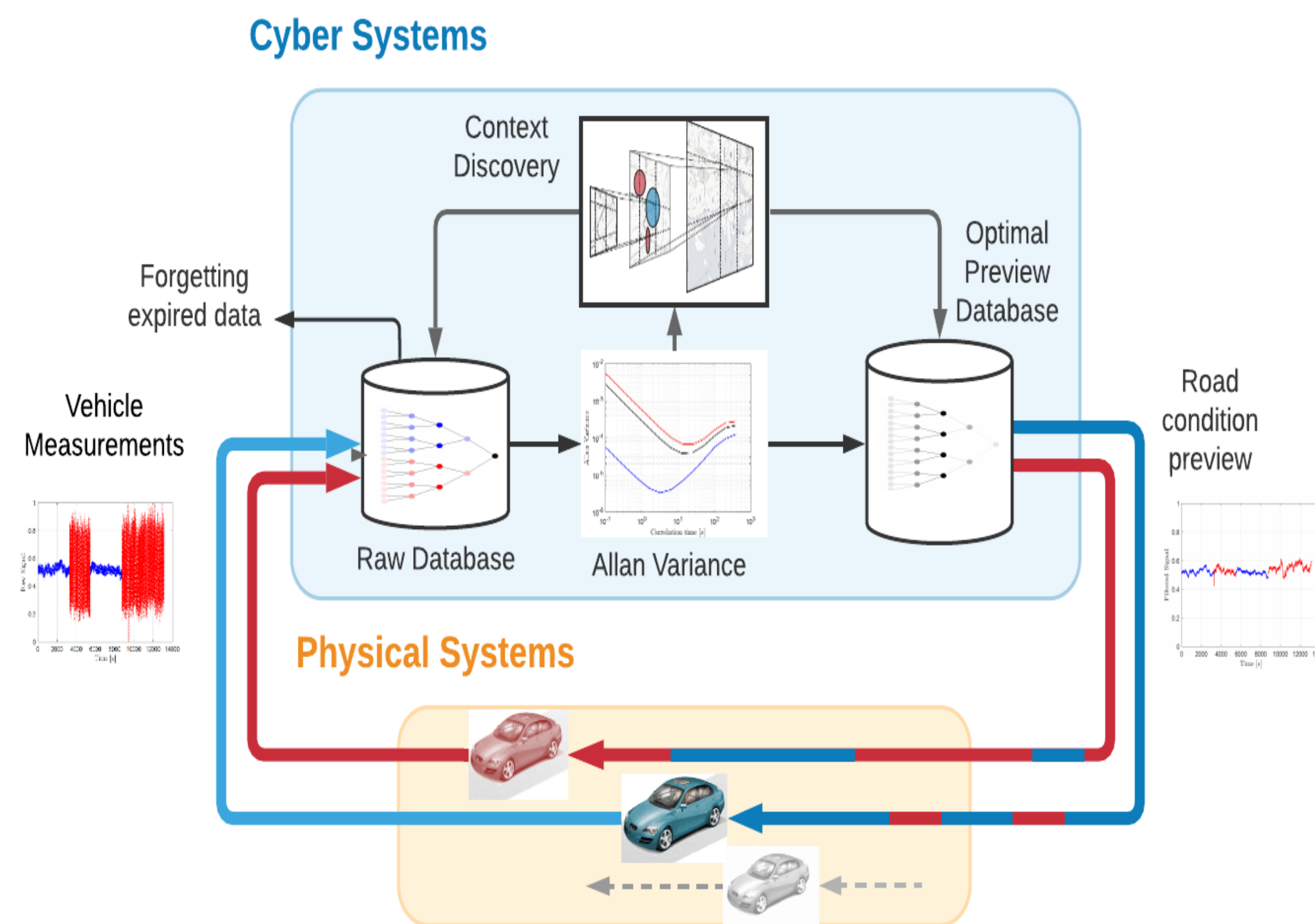
- We want databases to store and share data but need them to forget “old” data.
- We want vehicles to measure data, but each vehicle needs data recorded by others.
- We want the vehicles to maneuver enough to create accurate data but need vehicles to be stable.

Solution:

- Use Allan Variance (AVAR) to dynamically identify meaning of “old” data and optimal averaging windows.
- Develop idea of context to organize and discover properties of data that further refine variance.
- Organize database systems for optimal Allan Variance calculations.
- Test results via synchronization of regional-level traffic simulators with chassis simulators, and with a steer-by-wire instrumented vehicle.

Broader impact(potential impact)

- Code tools have 10^4 speed-up of AVAR calculations, effectively allowing real-time computation of AVAR for massive datasets.



Detection of surface friction conditions from a fleet of vehicles and the use of the aggregated data for safe operation of these vehicles.

Broader impact(education and outreach)

- Developed training codes and vehicle to support outreach, using undergraduate teams.
- Supporting 7 graduate students, 3 are female, 5 are minority.

Scientific Impact (2nd year):

- Fast variance codebase with 10^4 speed improvement.
- Proved variance method gives optimal averaging windows.
- Developed analytical solution for minimum preview necessary for chassis control with changing friction.
- Designed and tested database organization structures to support AVAR.
- Developed tools to encompass regions of influence (ROI) for perturbation analysis of vehicle impacts.

Broader impact(impact on society, safety and privacy)

- Privacy: Creating tools to allow personal information to be appropriately “forgotten” with no impacts on data quality of forgetful databases.
- Safety: Enabling vehicle to know the road ahead, to prevent instabilities that currently cause 4200 accidents a year.