Ghost Cars & *Fake Obstacles*: First Look at Control Software Stack Security in Emerging Smart Transportation

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Recent interest: Software security in smart transportation

Connected Vehicle (CV)

Autonomous Vehicle (AV)

U.S. Department of Transportation

TOYOTA

Aurora

Ford

GM

Qualcomm

WAYMO

lyft

Uber

apollo

TESLA

Recent interest: Software security in smart transportation

Connected Vehicle (CV) **Autonomous Vehicle (AV)**

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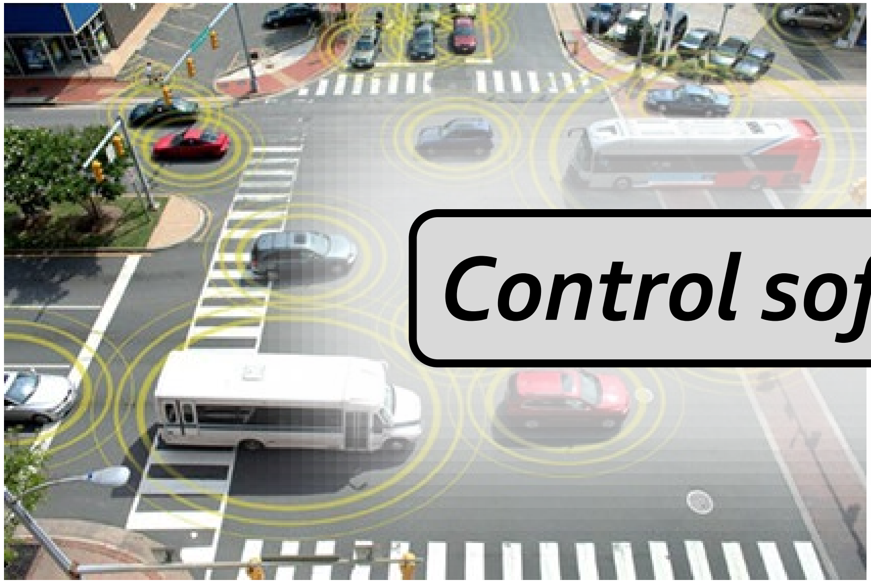
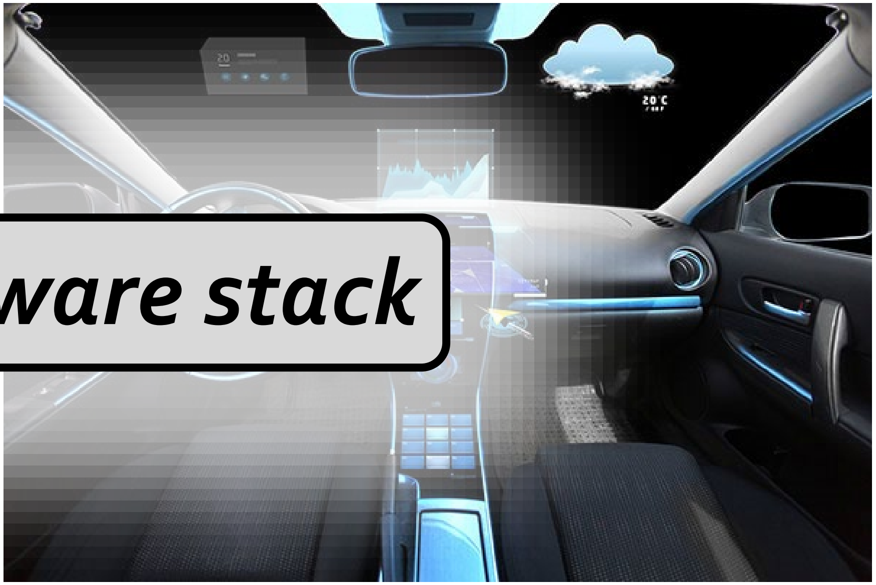
Connected Vehicle (CV)



Autonomous Vehicle (AV)



Control software stack

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Control software stack

[ISOC NDSS'18]
First software security analysis of a CV-based transportation system

[ACM CCS'19]
First software security analysis of LiDAR-based AV perception

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Connected Vehicle (CV)

[ISOC NDSS'18]

First software security analysis of a CV-based transportation system

- What: CV data spoofing on USDOT's smart traffic light control (for reducing congestion)
- How: Static & dynamic s/w analysis
- Finding: New security vuln at *traffic control algorithm* level
  - ***One single attack vehicle can create massive traffic jams!***
  - Demo time!

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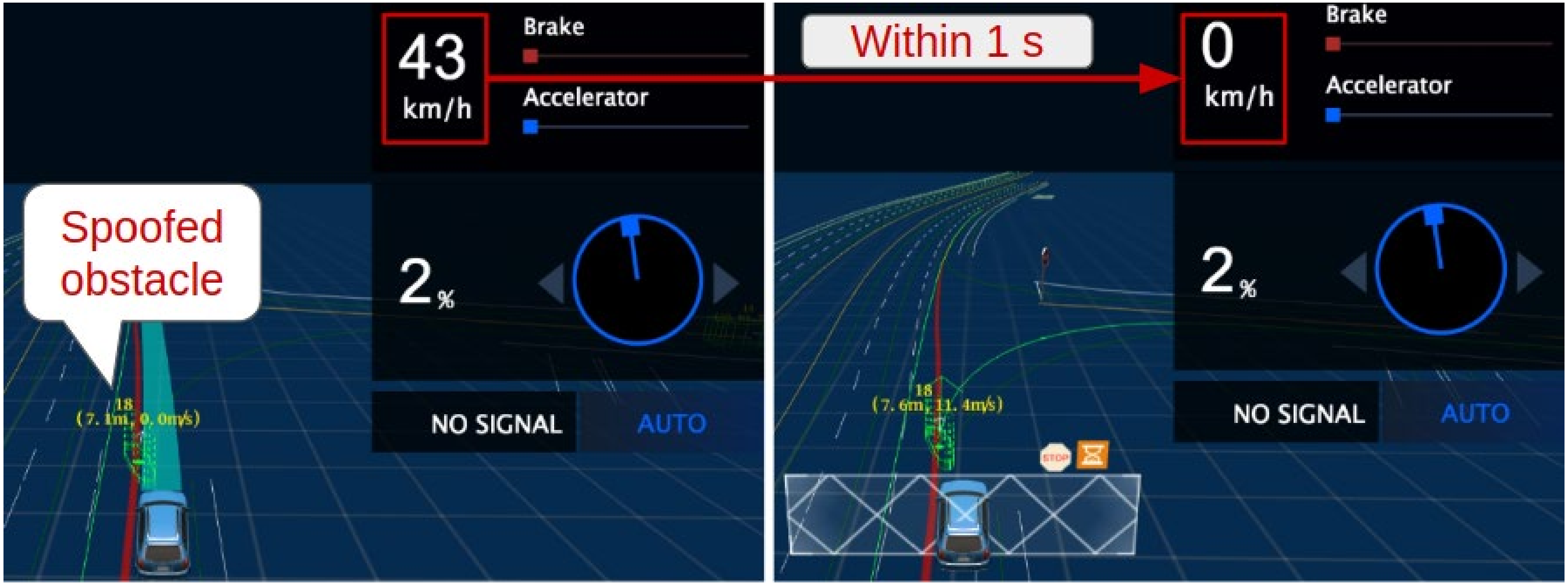
Autonomous Vehicle (AV)

- What: LiDAR spoofing on Baidu Apollo, a production-level AV
- How: Modelling & optimization
- Finding: Attacker can *strategically spoof* to **make AV "see"** ***fake front obstacle***

[ACM CCS'19]
First software security analysis of LiDAR-based AV perception

Security implication: Emergency brake attack

- Cause AV to decrease speed from ***43km/h*** **to** ***0 km/h*** within ***1 sec!***



Conclusion

- Initiated ***the first research efforts*** to perform security analysis of control software stacks in CAV systems
- Discovered ***new attacks***, analyzed ***root causes***, and demonstrated ***security & safety implications***
- ***Only the beginning*** of CAV software security research
  - Inherently an inter-disciplinary direction, ***always open to collaboration***!
  - Initiated the ***1st ACM AutoSec workshop*** to build community

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