Day 2, Session 1
Safety and other considerations

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Integrating Physiological Monitoring in the Industry

André Lourenço, CardioID

- Automated recognition of individuals from ECG signal – **your heart is unique!**
- Context-based physiological computing
  - Useful for the automotive for e.g. detecting drowsiness
- Technologies:
  - Materials as sensors for acquiring the ECG signal
  - Embedded systems
  - Machine learning
  - Security
- Many opportunities for collecting ECG data

Focus on automotive - drowsiness

- Application to bus driver monitoring
- Sensors on a steering wheel cover
  - ECG-based biometrics
  - Driver physiological monitoring
  - Drowsiness indication
- Communication using Bluetooth
  - Security challenges
- May use also other sensors
  - Steering wheel angle
  - Mobileye
- Dashboard for real-time monitoring
- Reports

From research to industry

- i-DREAMS project
- Valu3s use case
  - Verification and validation activities with HW-in-the-loop and fault injection

Questions

- Is there a significant difference between collecting signals from the steering wheel and signals obtained from clinical grade ECG?
  - The quality is comparably good, and the idea is to have cardiowheel classified as a clinical grade device
- What is the robustness of algorithms to uncommon signals?
  - From experience, million ECGs, the algorithms are good to identify the fundamental signal features and hence are robust
- If a driver takes one hand of the steering wheel, does it still work?
  - Multi-model and sensor fusion techniques will be required to compensate for the lack
  - Combine physiological data with eye blinking monitoring, to achieve more robust solutions – that will be the future

Questions

- How is mobileye used?
  - To obtain additional information concerning context and driver behaviour, for combining with the acquired physiological data
- Any specific data concerning benefits (reduction of accidents)?
  - No concrete data correlating to accidents (or their avoidance), only collection of events detected by the technology in relation to miles travelled

What Safety Challenges for Autonomous Systems Would Benefit from Research?

Timothy Tsai, Nvidia

- NVIDIA very much interested in autonomous vehicles
- Still no L4 autonomous cars (functions) in the market, but they should be there over the next 10 years
  - Still many concerns with liability issues
- Perception problems as root cause for disengagement

- 1st main challenge: How to improve perception
  - Manage the balance between functionality and safety

- HW faults also causing disengagements
  - About 5e5 FIT
- Very stringent requirements concerning random HW failures
  - <10 FIT (ASIL-D) – not calculated, should be 0.1 FIT!
- Error propagation is a fundamental aspect to consider
  - How to measure/estimate, without knowing the complete software stack

- 2nd main challenge: How to find expected error propagation for diferent modules?

- Very few architectural errors end up affecting the perception correctness - errors are masked
  - Several fault-tolerance mechanisms, e.g. sensor fusion, end up making these errors
  - Some errors are compensated (e.g., steering/braking)

- 3rd main challenge: Do random HW faults matter?
  - and
- What modules should be considered first, which are most relevant from the perspective of error masking?

- Coverage issues
  - Which scenarios are relevant?
  - Are all the relevant (safety-critical) scenarios being considered?
  - Are we testing perception sufficiently?
  - Is it possible to produce a benchmark of safety-critical scenarios?

Questions

- Relevance of Operational Domain Design (ODD) for disengagements?
  - If there's nothing to hit, then there are no sefety problems – knowing well the conditions is indeed very important
- Although there is a lot of error masking at architectural level, previous studies suggest that it is also possible to observe very serious failure modes (e.g., experiments with ABS). How to find these corner cases?
  - It is indeed difficult to find these cases
- Inappropriate maneuvre is caused by perception, or might it be another cause?
  - In principle caused by misclassification, but could be something else