Hercules in a nutshell

High-Performance Real-time Architectures for Low-Power Embedded Systems

- Jan 2016 to Dec 2018
- Budget: ~3.3M€

Industrial Advisory Board
- Provide feedback/advices
- Porsche, Finmeccanica, BMW, NVIDIA, Continental, Autoliv...
What do we do?

HERCULES
IN 2 MINUTES
Climbing the *Power Wall*

**Many-core platforms**
- Next-generation embedded systems
- Hundreds of G(FL)OPs, ~ 10W
- Commercial-Off-The-Shelf components

**Are they suitable for safety critical/real-time systems?**

**Not yet!**

**The keyword: predictability**
- Provide the correct result....at the correct instant
- Trade average for **worst case performance**
Hercules use-cases

- Outdoor valet parking system
  - Autonomous driving in structured setting
  - Real-time obstacle detection and avoidance
  - Path planning and parking maneuver

- Computer Vision for Aerial Application
  - Online machine learning for object tracking
  - Exacopter drone with guidance, navigation and control
  - Obstacle detection and avoidance
Hercules value chain

WHY ARE WE GOOD?
The Hercules toolchain

Programming model(s) abstraction

Hypervisor abstraction

“Big.LITTLE-like” core complex
E.g., 4 cortex A57 + 2 Denver

ISA subdomain #1

ISA subdomain #2

GPU management / firmware

GPU/FPGA

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..in other words..

A complete e2e toolchain to exploit many-core platforms in predictable manner

1. Analytic framework/methodology + supporting tools
2. Compiler + runtime for parallel prog. Models
3. RT-Operating System (Erika Enterprise + RT-Linux)
4. Compliancy with legacy SW (e.g., AUTOSAR)
5. NVIDIA-specific closed component... will be part of next NVIDIA drivers
Exploitation plan

WHAT DO WE DO WITH THIS?
Hercules assets exploitation

@consortium level
- HERCULES "Operating System"
- Partner-specific: MM, PITOM & Airbus
- IAB exploitation

@individual level
- Questionnaire
- Commercial: UNIMORE's Drivebox
- "Public": MASA + H2020 Class, Maserati ADAS project...
## Exploitation activities, form and market domain

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Lisbon – November 21st, 2018
# IP ownership

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...next?

(@UNIMORE)
The "HiPeRT Autonomous Driving Project"

Expensive: $60k
Bulky: Multiple servers and batteries
Power hungry: up to 5kW

Cheaper: ~1k
Small: Shoe box
Low power: less than 20W
The DriveBox

Example: The DriveBox
- Kit for semi-autonomous driving
  - (pedestrian avoidance, highway autopilot, ...)

- Safer driving at low SWaP
  - \ (~4-5k€
  - "A shoe box"
  - Less than 20W

- Optimized for power efficient platforms
  - Using open-source parts of the Hercules framework
Scale-out to smart cities

- The advent of autonomous vehicles challenges big data analytics systems
- The distributed nature of data sources makes current data analytics systems not suitable for smart cities

Two challenges
i. quick and reactive response
ii. a thorough and more computationally intensive feedback
Distributed awareness system
A real urban laboratory of one square-kilometre equipped with multiple (IoT) devices (e.g., smart cameras, traffic scanner and counter, smart parking, weather conditions) and network connectivity (4G, LTE)

Massive amounts of information processed in a data server to jointly cooperate for a so-called distributed awareness in the city area

Provides the necessary vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I) and vehicle-to-cloud (V2C) connectivity
EU-funded research

1. Intelligent traffic management, smart traffic lights and road signals
   - "Green routes", e.g., for ambulances, fire-fighters and police
   - Reduce fuel consumption and CO2 emission

2. Cybersecurity
   - ..... 

3. Advanced driving assistance to highly connected cars
   - VRU avoidance
   - Smart traffic lights
   - Driver monitoring
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