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Project Results

MACH

High-performance computing provides a competitive manufacturing edge

EXECUTIVE SUMMARY

MACH (MAssive Calculations on Hybrid systems) is a ITEA 2 project that heralds a new era of High Performance Extreme Computing (HPeC) that will allow HPC code developers to develop mission and performance-critical applications independent of hardware constraints and, as a result, companies to unleash the power of their applications on almost any kind of modern computing system.

PROJECT ORIGINS

Manufacturing contributes more than €6.5 billion to EU GDP and provides more than 30 million jobs. High-performance computing, HPC, is revolutionising the way products are designed and manufactured. But with new hardware architectures and features hitting the market much earlier and more frequently, predicting which hardware architecture will prevail is no easy task. At the same time the complexity of computing systems is increasing and the diversity of hardware accelerators present in HPC and HPeC systems growing substantially. MACH set out to meet the challenge of computation-intensive algorithms in a quickly changing hardware landscape and bridge the gap between traditional HPC and the high performance computing needed in the embedded computing world.

MACH Application areas

Fluid Dynamcis Simulation
- CFD
- Urban Terrain

Software Defined Radio

Reduced Order Models

Safety, Video Processing and Analysis

Bio-Statistics

Medical Imaging

C++ · Matlab · C++ · R · C++ · C subset — Domain Languages

TECHNOLOGY APPLIED

CThe project separated the concerns into 1) Domain Specific Language (DSL) for functional description and 2) a compiler and tuned kernels for performance. The project demonstrated that DSLs offer code portability and maintainability across different target platforms along with high-performance software from high-level entry and performance efficiency across diverse target domains such as driver assistance, machine learning, scientific simulation and traffic monitoring. The approach also focused on efficient heterogeneous embedded
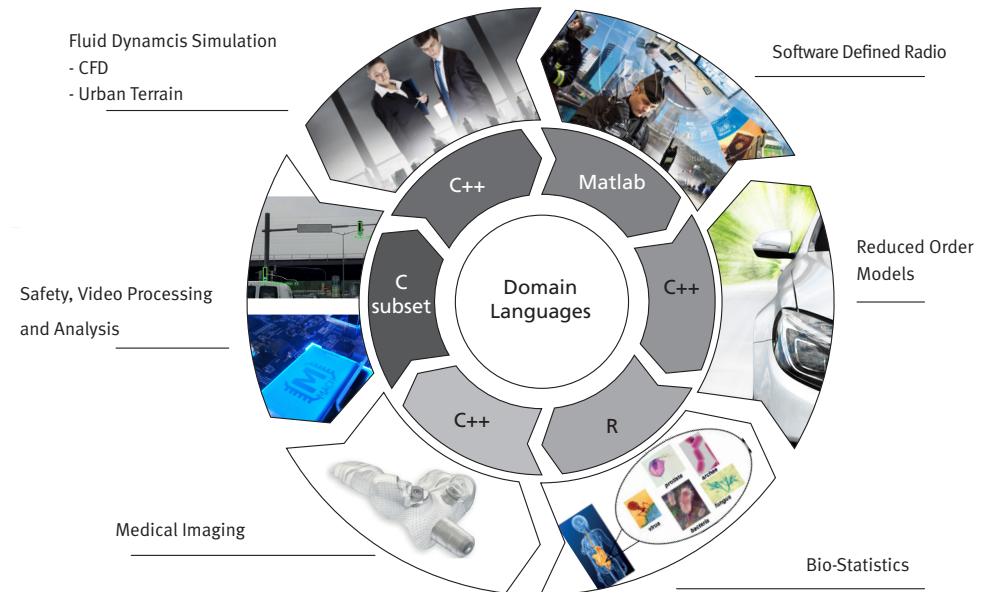
systems (low-power ECU NW, low-power ADAS, multi/manycore SDR, highly accurate timed simulations). DSL approaches are pursued everywhere to address the challenge of heterogeneity (e.g. Paypal, IBM Watson, Microsoft) and the importance of MatLab and R programming is growing. DSLs offer safety and enable smarter compilers. In terms of the project objectives, key achievements also included a MACH framework per domain and a performance benefit for use cases. The issue of standardisation covered by the project is a work in progress (AUTOSAR). The demonstrators showed a level of maturity,

examples being in ADAS (advanced driver assistance systems) in traffic light, traffic sign and lane departure applications, and in safety. The success of the technology effort is evident in the actual outcome: a COLD and HET-R compiler, an ADAS platform, an ECU network energy-saving framework using AUTOSAR, a LAMA framework (evolution from the LAMA numerical library) and Optimus Numerical Library.

MAKING THE DIFFERENCE

This fruitful research project delivered many innovative results whose potential

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commercialisation is considerable. The results have been achieved in multiple domains and multiple layers. The best expression of the impact of the project's results can be found in the project participants' exploitation plans. EOLON, for example, has a base brick for rapid prototyping with adequate performance (porting to accelerator ROI evaluation) and is building a fully accelerated HPDA tool chain, with the expectation of new hardware support (ARM, Power), with runtime extension and support for other languages. Infineon is using the results to boost the attractiveness of its latest multicore microcontroller platform and the novel hardware platform created in WP4 to help design new semiconductor solutions for ADAS and autonomous vehicles. Infineon expects to exploit the results worldwide and increase market share in automotive semiconductor solutions. The results of MACH essentially help to meet all the needs for the emerging market of autonomous vehicles and the MACH results will be integrated into future AUTOSAR specifications/standardisation. Nobel Biocare will release a new product using the Soft Tissue Simulator engine and expects to convert prototypes developed in MACH to production code as well as make more use of

multi-core CPU and GPGPU in future products due to experience gained through MACH. Noesis will be incorporating the Optimus Numerical Library and ensemble modelling in products and sees this as a competitive advantage. Silkan is releasing COLD version 2.5 and foresees increased income and manpower as well as future project collaboration. Thales will be employing the use of the workflow based on MyCCM in a new product line and improvements of the low-density parity-check will allow the exploration of new architectures, with potential integration in a new product line, and the development of a portable framework for multi and many-core. Vinotion is undertaking a pilot for Rijkswaterstaat, the Dutch national road-infra authorities and for the Dutch National police, with negotiations ongoing with Axis Sweden, RWS, ACS Taiwan, FETC tolling in Taiwan, etc. Finally, TWT has a CFD demonstrator for customer pitches and recruitment events, and sees potential use in existing business domains (automotive, aerospace) and newly developed domains (medical, energy, building). MACH not only reduces time-to-market for future products but it provides excellent business opportunities.

MAJOR PROJECT OUTCOMES

Dissemination
- #publications
- #presentations at conferences/fairs

Exploitation (so far)
- #/names new products + short explanation
- #/names new services + short explanation
- #/names new systems + short explanation

Standardisation
- # contributions to standardisation bodies

Patents
- # patent applications filed
- # patent application in preparation

Spin-offs
- #publications
- #presentations at conferences/fairs