

PROJECT RESULTS

CA701

A novel unified design methodology for the virtual prototyping of heterogeneous systems [H-INCEPTION]

H-Inception delivered a unified design methodology and tools to address the virtual prototyping of heterogeneous systems. This was largely in response to the problem with errors that often occur and are recognised too late in the design cycle, thus causing additional design spins and delays. This project ensures that industry performs system-design verification very early in the product development cycle, decreasing the time-to-market and system costs.

Consider the following (business) scenario. New types of emerging applications require microelectronics with embedded software which closely interacts with the surrounding environment in different physical domains – like optical, mechanical, acoustical and biological. However, design errors, such as functional incorrectness, wrong interfaces, or non-compliance (with the initial product specifications) often occur and are recognised too late in the design process. This leads to additional design spins and delayed schedules due to necessary reimplementation, which in turn disrupt marketing plans and launch targets. What to do?

Focusing on three key components

H-INCEPTION's response is a novel, unified design-methodology, and requisite tools to provide system-level design and verification for new types of emerging applications, especially those which require microelectronics to closely interact with the surrounding environment in different physical domains. It also proposed providing European industry with an ecosystem that delivered all the design-technology ingredients: from design and verification methodology to the essential modelling languages, together with simulation engines.

In order to address the virtual prototyping of multi-physical systems controlled by embedded software, H-INCEPTION proposed three key innovations:

- A methodology for system design, architecture exploration and verification;
- A 'correct by construction' approach for the integration of multi-domain systems;
- A system simulation framework.

Key project activities that followed are grouped as follows:

- Specifying multi-physics extensions (to IEEE standards) for P-XACT and SystemC;

- Development of the proof-of-concept simulator that embeds computational models for physical domains;
- Development of a framework;
- Validation of the key innovations through industrial applications.

H-Inception developed and delivered a framework with a simulator that validated the project results and deliverables through seven use-cases, covering wireless, consumer electronics, automotive, medical and printing. Key to the success of the project was the re-use and extension of two standard computer languages – SystemC for simulation and IP-XACT for model management and flow automation – widely deployed in industry for digital systems with embedded software, and whose capabilities the CATRENE project Beyond Dreams extended to analogue and hybrid systems.

Promising technical and operational benefits

A single kernel simulator based on SystemC extensions avoids the use of multiple simulators and their associated license costs. Furthermore, thanks to IP-XACT, the database is not proprietary and can be easily shared. The simulator is now available and can be downloaded freely from the H-Inception website. Industrial partners are deploying the methodology in the development of new products. Encouragingly, partners are integrating project outcomes into their tool offerings and services; and academic partners are promoting the languages in their courses. Project results are also expected to be reused in new collaborative projects.

Another project deliverable, the complete and open framework, is already available. It offers end-users a graphical interface with schematic entry, design assembly, checking and net-listing, together with useful links to the simulator. This framework is crucial to multi-physics system-developers who are used to working with such an interface. Furthermore,

PROJECT CONTRIBUTES TO

- ✓ Communication
- ✓ Automotive and transport
- ✓ Health and aging society
- ✓ Design technology
- ✓ Sensors and actuators
- ✓ More than Moore
- ✓ More Moore

PARTNERS

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|  France |  Netherlands |
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PROJECT LEADER

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KEY PROJECT DATES

December 2012 - December 2015

a common database for software, digital and multi-physics facilitates the communication between experts in a particular field.

Importantly, the virtual prototyping of seven applications for validation purposes also delivered and quantified such benefits as cost reduction, time savings and performance improvements – key criteria for time-to-market improvements. Test results were also most promising. Cost-reduction stood at 60% for the prototyping phase, and 15%-30% for manpower. Development time of the prototype was reduced by about 50%, from three to six months, thanks to the early development of software ahead of availability of hardware, and also to the re-use capability of the models.

On the performance side, virtual prototyping allows the simulation of multiple effects and hence increases design knowledge leading to system optimisation in such application areas as injection system for automotive applications; the autofocus speed in optics; MEMS control; and the optimised quantity of fluids in biomarkers.

Reinforcing Europe's leadership positions

There are also other types of benefits. To start off with, enabling technologies provided by H-INCEPTION will significantly improve the competitive position of European industry by allowing the co-designing of microelectronic platforms, and enabling European semiconductor companies and OEMs to keep pace (and outperform the competition) in the face of increasing complexity and heterogeneity required to maintain their leading position in system design and integration. SystemC, with its open-source, proof-of-concept implementation, will ensure European industry keeps its leadership position in the application of advanced system-

level design methodologies and tools. This will also result in better, high-quality products and systems, which will be available earlier on the market.

Furthermore, European semiconductor companies producing 'correct by construction' prototypes and delivering these virtual solutions to their system integrators will be able to reduce development time by six to ten months. Industrial partners will therefore be in a leading position to match customer demand and save development costs by introducing new 'proof-points' and reducing design iterations in the total value chain. This know-how will further strengthen Europe's pole-position in MDVP products and solutions, resulting in increased European competitiveness and employment.

Environmental, safety, security and healthcare improvements

And there are plenty of other areas where H-INCEPTION's effects will be felt. Project simulation demonstrates how optimising a vehicle's injector system can reduce vehicle CO2 emissions; and how costs and development time at a biomarker lab are significantly reduced, thus facilitating cardiac-disease detection. In addition, devices and embedded systems will offer more functionalities based on (wireless) connectivity and communication with their environment. Typical applications include toll payment with mobile phones; enhanced car-safety through road/traffic monitoring; using e-Passport for secure (internet) payments; wireless sensor networks for healthcare monitoring; and sensing technologies to improve, for example, the safety and comfort at work. Notably, these will go a long way to help support and secure European competitive power.

