– DELIVERABLE D8.10 (ex D7.10) –

Report on awareness and science & society-related aspects

Dissemination level: PUBLIC

– 23 September 2012 –

Next generation **Mu**lti-mechanics **S**imulation **E**nvironment

a Future and Emerging Technologies FP7-ICT European project

1. Societal impact

The NextMuSE project originated with requirements of important sectors of European industry, namely marine, hydraulic turbine and medical device engineering. These are areas of important economic activity which address needs of society, and where innovation will play a key role in the next decades.

The marine engineering sector is in constant development, with the growth of marine transportation of goods, and with the production of oil in deeper and deeper parts of the ocean. Besides, this sector knows a R&D boom with the advent of renewable marine energies (offshore wind turbine, current turbines, wave energy converters). The large majority of the European major industries of the offshore and energy sectors are involved in the world competition for deriving innovative solutions in the sector. In this competition it is crucial to accurately predict by numerical simulation the survivability of the energy converters in severe conditions. The SPH method developed and promoted in the project is meant to simulate this kind of situations. HydrOcean is now selling studies in this developing sector performed with this innovative method.

The highly competitive worldwide market of hydraulic turbines is presently dominated by European industries (ANDRITZ Hydro, Alstom, Voith Hydro). This leadership is challenged by growing industries in emerging countries (China, Brazil and India). To preserve their leadership European industries need to preserve a technological advance with respect to their new competitors. Simulation plays a key role here as well to be able to get the tenths of percent which make the difference. For Pelton turbines especially, the SPH method in the project is now routinely used at design stage in ANDRITZ Hydro. The project has also permitted to prove that we are now very close to continuous test rig based on this method used interactively which will reinforce the technological advance provided by the method itself.

Cardiovascular disease is the leading cause of death in Europe's ageing population. These are devices which regulate, manipulate and are loaded by flowing fluid. Worldwide medical device sales grew by 7% annually from 2004 to 2010, to USD 246 bn in 2010. Cardiovascular devices (including mechanical, bioprosthetic and tissue-engineered implants such as heart valves, grafts and stents) account for USD 39 bn of this market. Medical device technology is vital in facing the social challenge posed by an ageing population, and an increasingly important economic sector. However, innovation in this sector is relatively expensive. Computational modelling offers the potential for accelerated R&D on device mechanics. SPH has shown feasibility as a tool for some of the unique problems (moving walls, interactive geometric design).

NextMuSE directly impacts these three sectors by:

- demonstration of the SPH method applicability and reliability for current application;
- demonstration of the NextMuSE interactive simulation paradigm preparing future application.

This benefits directly to the project partners and to the research and development community in these sectors by:

- dissemination of enhanced numerical algorithms through scientific publication, online accessible content, etc.;
- dissemination of project results showing applications in these sectors;
- distribution of open source software (ICARUS/DSM/paraview-meshless).

After completion of scientific dissemination, the consortium plans to collect and publish NextMuSE outputs in the form of a book which will highlight demonstrated applications and potential future applications of the NextMuSE approach. This book will be made by collating the more interesting parts of the technical deliverables of the project.

Beyond the three targeted industrial sectors it benefits to many others (e.g. automotive, aeronautics, process…) where the SPH method is applied to simulate violent free surface flows and complex interface flows, as it is illustrated by studies made by ECN/HO.

Finally, the open-source material released during the project has an even wider range of application, which is highlighted by the high download figures of these tools (see deliverable D7.9):

- ICARUS could be plugged to any solver in principle, even though not all multimechanics solvers are naturally adapted to interactivity as is SPH;
- the virtual file driver H5FDdsm based on Distributed Shared Memory buffer can be useful to a very wide set of applications in engineering, physics, chemistry, IT… since it allows direct communication with any large parallel simulation running on a cluster;
- the visualization tool paraview-meshless applies to any particle method in any engineering/physics field (e.g. astrophysics, molecular dynamics…).

2. Education and training

NextMuSE has facilitated the development of a number of young engineers who will strengthen European research capability. NextMuSE has wholly or partially supported the following PhD students:

Jerome Soumagne	CSCS
Daniel Barcarolo and Matthieu Kerhuel	ECN
Salvatore Marrone	CNR-INSEAN

3. Public outreach

The consortium has taken opportunities to promote NextMuSE among the general public, and have exploited the project as a platform for the promotion of science and engineering in general. The following are examples.

- ECN and NUIG participated in a programme broadcast in May 2010 by Euradio Nantes.
- NUIG uses NextMuSE posters and videos in university open days (promoting engineering degrees to school students) and in Sea2Sky, a local family-oriented event as part of European Researchers' Night on September 28, 2012.
- ANDRITZ Hydro demonstrated live ICARUS simulation (similar to the one described in D7.4) at a company open day attended by approximately 100 members of the public in December 2011 in Vevey, Switzerland

The dissemination of results through public channels with a broad audience as YouTube also helps promoting the role of simulation in engineering among the general public.