SWEDISH NATIONAL COMMITTEE FOR THEORETICAL AND APPLIED MECHANICS

THE ROYAL SWEDISH ACADEMY OF SCIENCES

SNM seminar 12/2-2013

e-Science in Theoretical and Applied Mechanics

Abstracts:

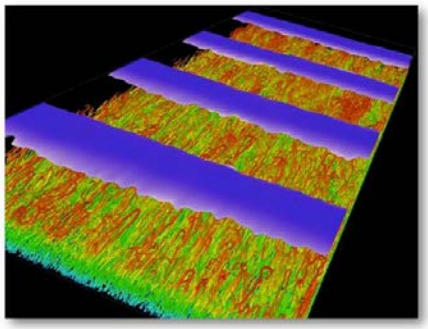
Professor **Dan Henningson (**KTH) **–** SeRC Swedish e-Science Research Centre

The Swedish e-Science Research Centre – SeRC

The advent of very large computers has introduced a third way of doing science, in addition to traditional theory and physical experiments. Numerical experiments on high performance computers has made novel investigations possible, in addition the possibility to handle and process huge amounts of data, coming from both numerical and physical experiments, have greatly contributed to new scientific results. This computer based research is called e-Science and is the basis for the formation of SeRC as a collaborative effort between KTH, LiU, SU and KI, funded as a strategic research area (SRA) initiative. SeRC brings together researchers within e-Science methodology and applications with computer experts at the computer centers PDC and NSC in interdisciplinary research teams to facilitate front line computational and data-driven science.

Docent **Philipp Schlatter** (KTH) **–**

Turbulence - what we can learn from large simulations



The turbulent flow close to solid walls is a major topic in today's research in fluid dynamics; the reason is obvious: a rough estimate says that about 10% of the total energy on the world is used to overcome turbulent friction in one way or another. Better understanding and thus the possibility to affect turbulence offers large ecological and economical savings. In the present talk, we discuss how we study turbulence using numerical simulations, and we show

a few examples of recent “virtual experiments”, such as turbulent boundary layers, pipes and diffusers. We will then see what insights we can obtain from the terabytes of data, and how our research can complement and extend experiments in real wind tunnels.

Professor **Göran Sandberg** (Lund university) **–**

e-Science, eSSENCE and some personal reflexions

Observations of reality have always been an essential part of science. From observations, we have identified patterns that in natural sciences have led to precise descriptions in mathematical language, which we now regard as "first principles". With computers came the opportunity to explore, to make observations of, "first principles" relations in increasingly complex systems. High-performance computer systems in the network with sensor systems (such as the upcoming MAXIV and various medical sensors) and databases of different types (and of course our curiosity) provides opportunities to seek new patterns and increase awareness of our surroundings. Quite recently has been coined a generic term for all this – e-Science.

eSSENCE is a collaboration within e-Science between Lund, Umeå and Uppsala University under the Government's investment in strategic research areas. e-Science rely heavily on e-infrastructure that SNIC (Swedish National Infrastructure for Computing) delivers through computer systems and different application experts. Especially the cooperation with Lunarc (LU), HPC2N (UmU) and UPPMAX (UU) is intensive.

This presentation gives some personal reflections on e-Science and exemplifies activities within eSSENCE.

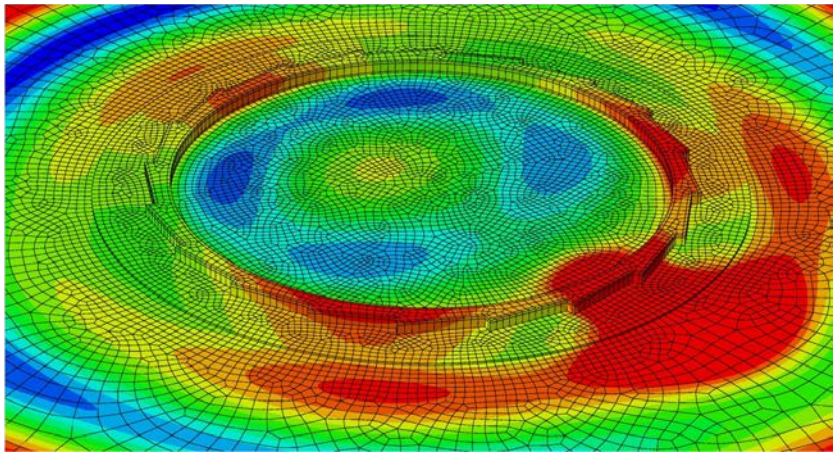
Professor **Göran Sandberg** (Lund university) -

Conceptual design for MAX IV in a high performance computing context

Computational Sciences – computational physics, ~ chemistry and ~ mechanics – started their journeys in the late 50's and early 60's. They belong to the legacy parts of e-Science

and have been of great importance for understanding and development of complex systems. Not least computational mechanics has also been of great importance for industrial development.

This presentation concerns thoughts on conceptual design and how computational mechanics can continue to develop both in an e-Science context, as well as in continued collaboration with the community and industry. This is illustrated with examples from the ongoing construction of MAXIV in Lund.



Docent **Stephen Hall** (Lund university) **–**

From images to quantified mechanics: new challenges in 4D image processing

Advances in imaging techniques (e.g., time-lapse x-ray tomography and 3D-volumetric digital image correlation) and their application in experimental mechanics have opened up many opportunities for observing material evolution in 4D (3D space plus time) at the micro-scale. However, to extract meaningful mechanical information from such images, to understand the mechanisms of deformation and to develop material models, requires new techniques for efficient multi-dimensional image analysis. Examples of the possibilities, challenges and possible solutions will be presented and discussed.

Professor **Örjan Smedby**(Linköping University) **–**

How can Mechanics and e-Science help solving clinical problems?

Normal function of the cardiovascular system depends on mechanical factors, and many diseases are manifested by altered mechanical function. This may be studied and simulated with advanced mechanical models, but to be useful to physicians in their clinical work, the results have to be summarized in measures that are easily understood

and familiar to the users, such as the pressure drop across an arterial stenosis.

Professor **Anders Ynnerman** (Linköping University) -
Scientific and medical imaging