Special Guest Lectures

Computing in Science Education. Integrating a Computational Perspective in the Basic Science Education

Morten Hjorth-Jensen, Michigan State University, University of Oslo

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Abstract:

In the last decades we have witnessed an incredible development of both computer hardware and software. Scientific problems that were previously solved on large special-purpose machines with special-purpose software can now be easily handled in general-purpose, interactive environments on standard PCs with the bonus of immediate visualization of the results. Surprisingly, the use of computers to solve mathematical problems still has little impact on university education around the world, particularly at the undergraduate level. Given today's dominance of numerical simulations in research and industry, we think it is paramount to integrate numerical tools at all levels in the educational system.

A fundamental challenge to our undergraduate programs is how to incorporate and exploit efficiently these advances within the standard curriculum in mathematics and the natural sciences, without detracting the attention from many of the classical topics. This brings with it the major organizational challenge of how to get university teachers in a variety of different fields and departments to work together towards such a reform. Furthermore, if students are trained to use such tools from the earliest stages in their education, do such tools really enhance
and improve the learning environment? In addition,and perhaps even more importantly, does it lead to better understanding and insight?

Although we don't have answers to all these topics, I will in this talk present one possible approach: Computational topics are gradually introduced in the undergraduate curriculum in several bachelor of science programs (undergraduate studies) at the University of Oslo (where I spend the fall semester), as an integral supplement to the classical scientific syllabus. Computations are introduced from the very first semester of study and linked up with the mathematics courses in the first and subsequent semesters. Furthermore, computational problems
are integrated in basically all compulsory undergraduate physics courses, allowing university teachers to strengthen research-based teaching at a very early level of study. A particular achievement of the Computing in Science Education project in Oslo is that we have managed to implement the computer-based methods by modifying existing science courses. I will present several examples from this project, with examples from courses across undergraduate programs as well as possible links to similar ongoing activities and potential applications.

Speaker's Bio:

I have been a Professor in theoretical nuclear physics at the University of Oslo since May 1 2001. I was an associate professor at the same university in the period January 1 1999 to April 30 2001. I got my PhD in theoretical nuclear physics in December 1993 at the University of Oslo and a Siv. Ing. (Master of Science equivalent) degree in March 1988 at the Technical University of Norway (NTH) in Trondheim. In the period August 1989 till December 1993 I was a research assistant (PhD studies) at the University of Oslo and a research associate in the period January 1 till September 30 1994 at the same place. In the period October 1 1994- December 1998 I was a post-doctoral fellow at the European Center for theoretical studies in nuclear physics, ECT* , in Trento, Italy and at the Nordita in Copenhagen, Denmark.

In December 2000 I shared the University of Oslo Excellence in Teaching Award with Arnt Inge Vistnes. In 2007 I became a fellow of the American Physical Society. In 2008, our team, David Dean, Gaute Hagen, Thomas Papenbrock and myself received the Oak Ridge National Laboratory award in the category for "Scientific Research" for our development and implementation of coupled-cluster theory for medium mass and neutron-rich nuclei.

My research interests span most of the areas decribed under these pages on computational physics and computational quantum mechanics in particular. The main focus has been and is on many-body methods for nuclear structure problems, but I have also done and continue to do research on Bose-Einstein condensation and the structure of quantum dots, in addition to studies of the mathematical properties of various many-body methods. In essence, my research can be summmarized under the topic studies of algorithms and methods for solving Schroedinger's equation or Dirac's equation for many interacting particles.

Center for Computation & Technology
2003 Digital Media Center • Telephone: +1 225/578-5890 • Fax: +1 225/578-8957