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SIAG/Geosciences Awards Two New Prizes at Leipzig Conference

A highlight of the biennial conference of the SIAM Activity Group on Geosciences, held this year in Leipzig, Germany, June 15–18, was the awarding of two new prizes: the SIAG/GS Career Prize, created to recognize outstanding contributions by a senior researcher, to Mary Wheeler of the University of Texas at Austin, and the SIAG/GS Junior Scientist Prize, intended for a young researcher in the geosciences who has made distinguished contributions in the three years preceding the award, to Jan Nordbotten of the University of Bergen. Faced in each case with several worthy candidates, the prize committee reached unanimous decisions in both.

Wheeler, the founding director of the ICES Center for Subsurface Modeling at UT Austin, has long been a central figure in the mathematical and computational geosciences. Even a list of her main research contributions over the last four decades would be too long to include here. Selected highlights date back to her now classic 1971 work on L^2 error estimates for finite element approximation of parabolic equations, and continue with her work, from 1974 on, in finite element superconvergence, with applications to improved flux computation, which is critical to work on subsurface flows. Beginning in 1983, Wheeler was a leading advocate of the use of mixed finite element methods in the solution of subsurface flow problems. Skipping ahead to the late 1980s, she (with Roland Glowinski) initiated the field of domain decomposition strategies for mixed finite element methods, a direction she would pursue for many years.

Wheeler is the driving force behind IPARS, the Integrated Parallel Accurate Reservoir Simulator, developed at the Center for Subsurface Modeling for use both in education and in the development of physical models of subsurface processes and their implementation in a high-performance parallel computing framework. With capabilities for modeling multiphase, multicomponent flows in porous media, coupled with geomechanics and reactive transport, IPARS scales nearly linearly and is one of the few high-performance simulators available for academic use.

In the course of her career, Wheeler has supervised about 55 PhD students and postdocs, many of whom have gone on to notable careers in academia and industry. She has had a substantial impact on the petroleum industry, largely through the industrial affiliates program of the Center for Subsurface Modeling.

Beyond these widely ranging contributions, Wheeler's tireless efforts were in large part responsible for the creation of the SIAM Activity Group on Geosciences. She was the group's first chair (1991–1995), and served subsequently as vice-chair (1995–1998) and as a member of the organizing committees for the first four SIAM conferences on geosciences.

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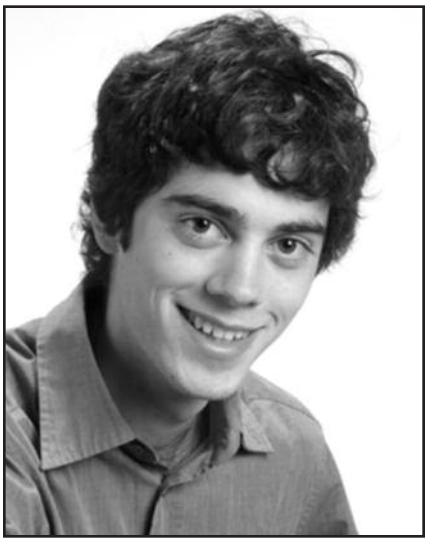
Since 2004, when he received a PhD in applied mathematics from the University of Bergen, Jan Nordbotten has made significant contributions to several widely ranging research areas. In 2006, he received one of the Norwegian Research Council's five-year awards for "excellent young scientists" to establish a research group in the area of multiscale methods with applications to porous media. He is now an associate professor at Bergen, where he is a member of the Center for Integrated Petroleum Research; he is also a driving force in several national and international projects related to CO_2 sequestration.

The SIAG/Geosciences prize committee cited Nordbotten "for important contributions to mathematical and numerical analysis of problems in CO_2 injection and leakage," as well as for his work in two other areas: analysis and computation of stochastic PDEs describing soil–water–plant dynamics, and development of monotonicity criteria for a broad class of control volume discretization methods for porous media flows, which has led to improved understanding of existing methods and the development of new, more robust methods.



Jan Nordbotten, recipient of the first SIAG/GS Junior Scientist Prize.

Helge Dahle, Nordbotten's thesis adviser at Bergen, and Michael Celia, with whom he first worked as a visiting graduate student at Princeton University, both describe Nordbotten's work as demonstrating not only strong mathematical talent, but also deep understanding of physics and the ability to apply physical intuition and insight to guide his mathematical developments. This ability was particularly evident in his work on the modeling of CO_2 injection.

Nordbotten began to work with Celia on problems of modeling CO_2 injection over large, heterogeneous (usually layered) domains with hundreds of high-permeability streaks, each corresponding to an abandoned well. The streaks, which can link various geologic layers, represent leakage pathways for the CO_2 and therefore must be studied in detail. Because of the large uncertainties associated with the material properties of the wells, a stochastic, Monte Carlo approach is needed. Only extremely efficient solutions will allow many hundreds or thousands of model runs, as required in the Monte Carlo approaches.

Celia challenged Nordbotten to devise an analytical solution to the two-phase flow problem and received, to his surprise, "a series of increasingly comprehensive solutions that apply to many practical situations associated with CO_2 injection." Among them are semi-analytical solutions that model leakage from one layer to another, as well as CO_2 spreading within layers. These semi-analytical solutions provide quantitative assessments of leakage that cannot be obtained with traditional numerical simulators.

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Having inaugurated its prizes with two such worthy recipients, SIAG/Geosciences looks forward to recognizing similarly outstanding achievements at future meetings. The prizes will be awarded for the second time in 2011, at the next biennial SIAG/GS conference.

Information about that meeting and both prizes will be posted as available at http://wiki.siam.org/siag-gs/index.php.—Assembled by SIAM News*, on behalf of the SIAG/Geosciences Prize Committee.*

Presenting the Theodore von Kármán Prize to Mary Wheeler at the SIAM Annual Meeting in Denver, SIAM president Doug Arnold mentioned that just a month earlier she had been recognized "by her own tight geosciences community," which named her the first recipient of the SIAG/Geosciences Career Prize (see accompanying article). She was cited in that case "for deep, broad, and sustained contributions to the mathematical and computational geosciences," as well as for her "instrumental efforts to establish and grow the SIAG/Geosciences."

The more voluble von Kármán committee recognized Wheeler "for her seminal research in numerical methods for partial differential equations, her leadership in the field of scientific computation and service to the scientific community, and her pioneering work in the application of computational methods to the engineering sciences, most notably in the geosciences."

"For a generation," the citation continues, "she has been at the forefront of efforts forging connections between mathematics and engineering, and between academia and industry. Over the past decade, she has made fundamental research contributions developing and applying state-of-the-art algorithms and computational science tools to problems of societal importance in energy and the environment." Wheeler chose to focus her 30-minute von Kármán lecture on the modeling of carbon sequestration.

The SIAM Theodore von Kármán Prize is awarded every five years for an outstanding application of mathematics to mechanics and/or engineering during the preceding 5–10 years.