MODERN SIMULATORS

10 Numerical Simulation of Thermomechanical Processes Coupled with Microstructure Evolution
Tiago C.A. Colombo, Alberto M.G. Brito, and Lirio Schaeffer
The finite element method is already used in metal forming at an industrial scale. However, progress is needed regarding the microstructure optimization of components produced by metal-forming processes such as hot forging or rolling. This article presents mathematical models to predict microstructure evolution during hot working, showing the models’ application coupled to thermomechanical processes’ simulation software.

16 20-Bit RISC and DSP System Design in an FPGA
Amit Kumar Singh Tomar and Rita Jain
Today, most microprocessor and microcontroller designs are based on a Reduced Instruction Set Computer core with several operations performed by a digital signal processor system. Here, the design of a RISC and DSP system is presented that uses very high-density logic (VHDL) and a field-programmable gate array (FPGA). This RISC is a 20-bit processor.

22 User-Steered Energy Generation and Consumption Multimodel Simulation for Pricing and Policy Development
Harrison B. Smith, Amy Pielow, Adithya Jayakumar, Matteo Muratori, B.J. Yurkovich, Ramteen Sioshansi, Ashok Krishnamurthy, Giorgio Rizzoni, and Matthew C. Roberts
Although simulation is valuable for understanding energy use, such models are simplified abstractions of actual energy systems. Here, an adaptable framework is presented for integrating and developing multimodel simulations. This framework allows independent development of component simulations, limits coordination overhead between developers, and allows modularity and flexibility in the overall multimodel simulation.

34 Survey of Multiscale and Multiphysics Applications and Communities
Derek Groen, Stefan J. Zasada, and Peter V. Coveney
Multiscale and multiphysics applications are now commonplace, and many researchers focus on combining existing models to construct new multiscale models. This concise review of multiscale applications and their source communities in the EU and US outlines differences and commonalities among approaches and identifies areas in which collaboration between disciplines could be particularly beneficial.

For more information on these and other computing topics, please visit the IEEE Computer Society Digital Library at www.computer.org/csdl.
44 Reveal: An Extensible Reduced-Order Model Builder for Simulation and Modeling
Khushbu Agarwal, Poorna Sharma, Jinhang Ma, Chaomei Lo, Ian Gorton, and Yan Liu
Many science domains need to build computationally efficient and accurate representations of high-fidelity, computationally expensive simulations known as reduced-order models (ROMs). The Reveal toolset generates ROMs based on science- and engineering-domain-specific simulations executed on high-performance computing (HPC) platforms. This article describes the Reveal architecture and demonstrates its use.

54 A Multiscale Code for Flexible Hybrid Simulations Using ASE Framework
Lauri Leukkunen, Tuukka Verho, and Olga Lopez-Acevedo
Multiscale computer simulations combine computationally efficient classical algorithms with more expensive—but more accurate—ab initio quantum mechanical algorithms. This implementation of multiscale computations uses the Atomistic Simulation Environment (ASE) to combine different simulation codes (both classical and quantum mechanical) with ease and minimal coding effort.

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