Report—NIST-RILEM Doctoral Course

25th Annual NIST Computer Modeling Workshop

National Institute of Standards and Technology
Gaithersburg, Maryland USA 20899
June 9–10, 2014

Participants

A total of 27 participants attended the course. By nationality of the participants, four countries were represented, including Canada, China, Mexico, and the United States. Of the participants, 10 were graduate students, four were professors at academic institutions, three were government researchers, and ten were industry researchers.

Scope and Objective of the Course

Computational materials science continues to be used as a research discipline for studying the processing, structure, and properties of cementitious materials. A materials science approach to modeling requires both innovative modeling and simulation techniques as well as a close connection with experimental research, the latter providing both model input and validation. This workshop emphasized both modeling techniques—spanning lengths scales from nanometers to millimeters—and experimental methods for characterizing the structure and properties of cement and concrete materials. The objective of the course was to provide a broad introduction to computational and experimental techniques for studying cementitious materials, appropriate for graduate students and researchers in academia and industry.

Course Instructors

The following NIST personnel and guest lecturers facilitated the workshop lectures and tutorial:

- Jeff Bullard, Dale Bentz, Chiara Ferraris, Ed Garboczi, Nicos Martys, Paul Stutzman, Ken Snyder (NIST, Gaithersburg, Maryland, USA)
- Joseph J. Biernacki (Tennessee Technological University, Cookeville, Tennessee, USA)
- Zachary Grasley (Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA)

Course Content

The course consisted of a series of 10 tutorial-style lectures on various computational techniques and experimental methods suitable for research on

cementitious materials. It also included a hands-on exercise period during which participants installed the most recently released version (9.3) of NIST's Virtual Cement and Concrete Testing Laboratory (VCCTL) software on their laptop computers and conducted virtual experiments in creating, hydrating, and testing mortar specimens. Finally, the course included opportunities for participants to give 15-minute oral presentations of their own research interests.

The specific lecture topics were:

- Principles of modeling cement and concrete
- Microstructure in cementitious materials
- Computer modeling cement hydration at early and late ages
- Modeling creep and relaxation of cementitious materials
- Sustainable concrete materials: experiments and modeling
- Mathematical modeling of cement hydration
- Estimating aggregate shapes and sizes from orthographic projections
- Experimental and computational rheology of fresh cement, mortar, and concrete
- Reconstruction of 3D cementitious microstructures

Scientific Support by RILEM

The scientific sponsorship by RILEM was described at the beginning of the course, consisting of a 5-minute introduction in which the history of RILEM, its principal activities and committees were introduced and RILEM's web page was shown to the participants. Furthermore, information was given on the complementary 3-year membership offered to participants in the RILEM doctoral courses and possible participation in RILEM committees was discussed with the group.

Workload

The workload of the course was approximately 16 hours, including lecture periods and computer exercises.

Continuation

A workshop with closely related topics is expected to be offered in Summer 2015.