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Two adjectives seem to dominate our world nowadays: *cyber* and *virtual*. Cyber is predominantly used in connection with all kinds of networked environments, and best known from "cyberspace." Virtual has the persistent notion of "not real." A virtual reality is an example of this balancing between visualization of nonexistent items and a modern equivalent of a *fata morgana*.

At first sight, instrumentation and measurement do not seem likely candidates to mix with these adjectives, but the opposite is true. The ever-growing computational power and available network bandwidth have qualitatively changed the structure of instrumentation and measurement. As a result, the concept of virtual instrumentation has been introduced. In this case, "virtual" stresses the fact that the functionality of the virtual system (VI) is augmented transparent to the user through software processing techniques. Furthermore, a number of VIs are hardly imaginable without software.

Virtual environments add to this yet another dimension. Until recently, researchers and measurement tools shared one common, real world. However, with the advent of virtual environments, this limitation has lifted. Now, it is possible to interactively explore and study the "real world of data" in a virtual environment chosen by the researcher. This necessitates a radical rethinking of instrumentation and measurement paradigms.

In the IMTC conferences, an increasing number of special sessions devoted to these topics bear witness to their growing importance. This year, an inspiring workshop entirely devoted to this exciting field, organized jointly by Technical Committees 15 and 22, was held prior to IMTC.

Thus, at the turn of the millennium, is seems appropriate to devote a special issue of the *Magazine* to chart the progress in the field of virtual instrumentation and measurement in virtual environments.

This is done via four contributions. The first, "Virtual Instrumentation and Virtual Environments," charts the various phases in the development, from traditional computerized instrumentation and measurement to measurements in virtual environments. It discriminates among three phases: from instrument to virtual instrument, from monolithic programming model to graphical user interface, and from real to virtual environment. We are at the transition into the third phase, in which virtual environments can effectively be integrated into the instrumentation-and-measurement process. This makes clear the need for a standardized approach to prevent counterproductive diversification of tools and paradigms.

The contribution by Cristaldi, Ferrero, and Piuri, "Programmable Instruments, Virtual Instruments, and Distributed Measurement Systems: What is Really Useful, Innovative and Technically Sound?" takes a closer look at the first two steps of this process and measures the true progress from the user's point of view. Indisputably, the changes and improvement are enormous, as are the hidden dangers of researchers blindly trusting the measurement system and forgetting the lessons of the art of measurement. It ends with the warning: "On the other side, the evolution of these measurement systems must be pushed toward self-evaluating systems that are able to warn the users about the presence of possible error conditions, and to self-estimate the measurement uncertainty."

In the third contribution, "Environmental Exploration: An Autonomous Sensory Systems Approach," by Wide, Saffiotti, and Bothe, the new approach to the remote exploration and inspection of a dynamically changing environment is charted. They focus on a surveillance task in which a robot (or a fleet of robots) patrols a building, measures unexpected changes, and reports back to a human. This sensor-rich, semi-autonomous mobile platform performs multi-modal data collection, processing, and fusion at various levels of abstraction and at various resolutions. The fused information is integrated into a virtual environment, which is presented to the user as an example of the mixture of real and virtual worlds.

Finally, Steenput and Rolain stress in their contribution "Caching in Dataflow-Based Environments," that, even in this world of fast processors, it pays to be careful with computational cycles. Instrumentation and measurement processes can be conveniently mapped onto dataflow-like systems in which the interdependencies of modules are specified. The authors carefully explore the possibilities for efficient use of caches in such schemes. Despite the fact that the networks that interconnect today's instruments are fast, a message may still take substantial time to travel from (device) A to (device) B, making such a study very instructive.

Clearly, the state of the art is bound to be different in a few years time. Yet, the methods and lessons from the measurement-and-instrumentation world will be indispensable to anyone working in this field. However, the threat of unmoderated growth and diversification is all too real. Therefore, the workshops and conferences mentioned earlier should serve as a platform to foster new standards, which, in turn, will give the proper direction to this development.