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EDITORIAL

Computer modelling and simulation: essential research tools

Many countries have made vast advances in national development through appropriate and timely science and technology interventions. Most important among these initiatives is research, which leads to innovations and a knowledge economy. Today, researchers depend heavily on computer modelling and simulations to study and research into the dynamic behaviour of real systems.

Computer modelling is a powerful research tool available to scientists to study the behaviour of systems in areas such as agriculture, water resources, weather and climate, economy, energy systems and environmental pollution, among others whose performance depends on multiple dynamic variables acting simultaneously. To carry out such studies, it is essential to develop computer-based models, which express the response as a function of each of the variables. However, to develop such models, it is important to carry out field studies and determine the response to changes in each of the parameters separately. The forecasting of important socio-economic systems is important for understanding future trends of the contributions of such systems to the national economy. Computer modelling thus becomes an essential tool for research-based national planning.

In many instances where computer models are used by researchers and planners in the country to study the performance of various systems in different areas, the general practice is to make use of propriety software available as commercial products. These software packages in addition to being expensive, have a limited validity period necessitating regular revalidation and cannot be shared. They may also not fully suit the specific requirements of the researcher. The source-code of these software packages is not generally made available to users, which disallows them making necessary changes to the software themselves.

Hence, the best option is for the researchers to develop their own software and computer models to suit the specific requirements. This necessitates the researchers to express their findings on response-stimulus relationships into mathematical expressions, and the computer scientists to convert these sets of mathematical expressions into an algorithm and a computer programme working jointly. Much financial resources and time could be saved by experimentation using computer models. Our scientists should therefore develop competency to develop such models as part of their research training, similar to acquiring training in the application of statistics, which has become the standard practice today.

Today, computer literacy is a requirement for all students. However, such knowledge is in most cases limited to using standard software packages for various applications. This is inadequate for research scientists. Computer modelling for researchers should go beyond using the standard software packages. It is a multi-faceted exercise, which could be best carried out jointly by researchers, mathematical scientists and computer scientists working as a team in order to solve specific problems. Computational science has now become a sub-discipline within each scientific discipline.

As stated previously, computer modelling and simulation use computers to represent the dynamic behaviour of real systems. Simulation uses a mathematical description, or model, of a real system in the form of a software system. When the software system is run, the resulting mathematical dynamics form an analog of the behaviour of the real system, with the results presented in the form of data. A simulation can take the form of computer graphic visualization, which represents the dynamic behaviour of the real system in graphical form.

A major advantage of a simulation system is that it can be used to study the dynamic behaviour of systems in situations, where real systems cannot be easily or safely applied. Computer modelling and simulation can also be used to understand and evaluate 'what-if' case scenarios. Some examples of computer simulation familiar to most of us include weather forecasting, flight simulators, ship

handling and driving simulators. In the medical field graphical anatomy visualization and virtual surgery are widely used simulations. The availability of advanced mobile devices with many sensors and internet capability, several mobile based simulations such as virtual tour, interactive mobile virtual environments have also been developed.

The Modelling and Simulation Group of the University of Colombo School of Computing (UCSC) is engaged in many collaborative simulation research studies. These studies include 'ViduSayura' a ship handling simulator (Sandaruwan *et al.*, 2012), 'Siyara' a harbour environment simulation and management system (Gunasekera *et al*., 2012), an artillery gun firing simulation and a fighter jet cockpit simulation. A virtual environment visualization system, 'Virtual-Eye' has also been developed, which can be used to visualize virtual environments on mobile devices (Ranaweera *et al.*, 2012).

This has been made possible because of the capability and skills of the staff at the UCSC in the development of software, computer modelling and simulation. It is the responsibility of every university and research institute to provide their staff with similar knowledge, skills and training to develop the software needed for computer modelling and simulation, which the researchers could apply in their own studies.

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