Systems Modelling and Simulation

In the context of design and development of engineering systems, the design process normally starts with a conceptual framework of the desired system and then proceeds with the preliminary and detailed design steps. However, in order to ensure that the designed product will meet the stated objectives, we need to assess the performance of the design at each and every stage. This requirement results in the need to create representative models of such systems which can be simulated under suitable operational conditions, in order to ascertain the performance of the design. Systems modelling and simulation discipline is the field that enables such verification of the design at every stage of the development process.

Systems modelling and simulation involves representation of the designed system in the form of various types of models such as mathematical, analogous or physical, which can be solved using various techniques e.g. analytical, numerical and experimental. The modelling discipline aims to capture the physical process in a synthetic form, which is a simplified version of the design, but captures the essential features so that its behaviour represents to a great extent, the behaviour of the actual product, once it is realized. Simulation, by definition, is nothing but the solution or activation of the model using synthetic inputs, in order to have evolution of its behaviour in time domain, either in a closed mathematical form, or more commonly, as a graphical or visual form. In most cases, a visual or graphical form of solution is preferred as this gives a better feel for the behaviour of the design and is also amenable to parametric study for exploration of the design space. In general, the complexity and detailing of the model and sophistication of the simulation process depends on the level of information available about the design as well as the requirements of accuracy in representing the system behaviour.

The present short course is intended as an introductory material with regard to the concepts of modelling of systems and their simulation, in terms of model types, simulation methods and response representation. The participants can expect to acquire basic knowledge about how to build good models that capture the underlying physics and also how to generate the desired behaviour. The course is of twelve hours duration and is delivered over six weeks.