Generalised Continua and Scale Effects
Theoretical Frameworks and Numerical Implementations

Classical continuum formulations exhibit serious shortcomings. In addition to solution singularities present in the context of unsmooth geometries or loading, classical theories of deformation do not provide internal length scale and so do not exhibit scale effects readily observed in experiments. Not only are scale effects relevant when the specimen or structures dimensions themselves are in the micron and submicron scale but also when it comes to high strain concentrations as in the case of localised shear bands or at crack tips etc. In this context so-called generalised continuum formulations have proven to provide remedy as they allow for the incorporation of internal length scale parameters which reflect the micro-structural influence on the macroscopic material response.

Generalised continua are characterised by extra degrees of freedom or incorporate higher gradients of the degrees of freedom. They exhibit naturally one or multiple internal length scales and allow for non-classical loading such as moments to apply. They overcome deficiencies of classical formulations whenever internal scales matter such as in micro devices, damage evolution, shear band developments etc.

In addition, generalised continua provide a natural access to theories of reduced dimensions such as shell and rod theories. The numerical treatment of the extra degrees of freedom such as rotation is not straightforward and innovative methods are often necessary.

The seminar will present a unified framework for generalised continua. New formulations for such continua and deformations are considered including whole numerical frameworks. Various numerical examples stretching from structural dynamics, inelastic deformations at finite strains to electromechanical coupling substantiate the theoretical approach.