Discontinuous Galerkin solver for the unsteady advection-reaction-diffusion equation. Applications to the simulation and parameter identification of a root growth model

Yves Dumont, Thierry Fourcaud, Emilie Peynaud,
UMR AMAP, CIRAD, Montpellier, France
emilie.peynaud@cirad.fr

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Root systems are important for plants but they are difficult to study because of heavy constraints of field experiments. Modelling and simulation of root systems are crucial tools to better understand root systems, but also to design new experiments. Among the various modelling approaches, the density approach consists in following the evolution over time and space of the root biomass density in the soil. The root density satisfies an unsteady advection-reaction-diffusion equation with coefficients varying in space and time according to the physiological phases of the root growth. At the moment there is no direct field experiment that can estimate or measure some of the coefficients of the equation. But since we know how to estimate the root density the missing coefficients are determined by solving an inverse problem. The problem is solved on unstructured meshes so that it allows the treatment of complex geometries and mesh refinements. It is well known that the Lagrange finite element method suffers from a lack of stability because of the advection term. Since our applications require the treatment of discontinuous parameters for example in the case of a stratified soil, we implemented an approximation based on Discontinuous Galerkin (DG) method. In the talk, we briefly present the DG method applied to root growth simulations. Then, we address the inverse problem of parameter identification which reduces to a non linear optimization problem and we show some numerical experiments.