Linear and nonlinear complementarity problems with an application for flow in porous media.

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Complementarity problems arise in many applications even though they are not always identifed as such. Contact problems are an area where they have been thoroughly studied, but there is now a renewed interest in complementarity problems for various applications arising in modeling flow in porous media. We begin this lecture by presenting the framework for linear problems and discussing existence and uniqueness of solutions. We also present the nonsmooth Newton method for solving complementarity problems numerically. Then we move to nonlinear problems by presenting a problem arising in modeling migration of hydrogen produced by the corrosion of the nuclear waste packages in an underground storage. The model is that of gas-liquid flow with hydrogen dissolution in water. The mathematical model that we use is a set of nonlinear partial differential equations with nonlinear complementarity constraints. We show how to use the Newton-min method to simulate the appearance and disappearance of the gas phase and demonstrate the efficiency of our solver on a numerical experiment.