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Geometric Algorithms for PDAE and DAE

Highly nonlinear implicit DAE and PDAE occur frequently in applications. Algorithms that treat such systems almost always make two key assumptions:

The system is (i.e., number equations = number unknown functions)

There is effectively only 1 irreducible component (or manifold) of solutions

Any algorithm that claims completeness, must be able to determine solutions of systems with more than 1 component and also deal with non-square systems. I will describe progress on designing such algorithms, and also related progress on implementation. I will start with the algebraic case, and numerically stable methods from the new area of numerical algebraic geometry, based on rigorous globally convergent homotopy continuation methods. Then I will discuss the extension of these continuation methods and their implementation to systems of DAE and PDAE. The flavour will be introductory and the geometric ideas illustrated visually, and with examples.

This is joint work with my collaborator Wenyan Wu.