A new perspective on the complexity of interior point methods for linear programming

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In a dynamical systems paradigm, many optimization algorithms are equivalent to apply- ing forward Euler method to the system of ordinary differential equations defined by the vector field of the search directions. Thus the stiffness of such vector fields will play an essential role in the complexity of these methods. We first exemplify this point with some theoretical results for general linesearch methods for unconstrained optimization, which we further employ to investigating the complexity of a primal short-step path-following interior point method for linear programming. Our analysis comprises showing that the Newton vector field associated to the primal logarithmic barrier is nonstiff in a sufficiently small and shrinking neighbourhood of its minimizer. Thus, by confining the iterates to these neighbourhoods of the primal central path, our algorithm has a nonstiff vector field of search directions, and polynomial iteration complexity.