=============================================

Hans De Sterck (Univ of Waterloo, Canada)

Efficient solution of stationary Euler flows with critical points and shocks

It is well-known that stationary transonic solutions of the compressible Euler equations are hard to compute using the stationary form of the equations. Therefore, time marching methods with explicit or implicit time integration are normally employed. However, the computational complexity of the time marching approach is far from optimal, because convergence tends to be slow and tends to slow down even more as resolution increases. In this talk we explore the alternative of solving the stationary equations directly, which is a viable approach when the solution topology is known in advance. We first present a solution method for one-dimensional flows with critical points. The method is based on a dynamical systems formulation of the problem and uses adaptive integration combined with a two-by-two Newton shooting method. Example calculations show that the resulting method is fast and accurate. A sample application area for this method is the calculation of transonic hydrodynamic escape flows from extrasolar planets and the early Earth, and the method is also illustrated for quasi-one-dimensional nozzle flow and black hole accretion. The method can be extended easily to handle flows with shocks, using a Newton method applied to the Rankine-Hugoniot relations. Extension to flows with heat conduction is also discussed. The presentation will conclude with some thoughts on how the approach presented can be generalized to problems in higher dimensions.