Approximation schemes for stationary compressible viscous flow

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In this talk new iteration schemes for the numerical approximation of steady compressible viscous flow are presented. Despite the importance of the Poisson-Stokes equations for physical applications, their numerical approximation is almost unexplored. Their mixed elliptic-hyperbolic character causes severe problems in constructing effective numerical methods. Our schemes are based on an iteration between an Oseen-like problem for the velocity and a transport equation for the perturbation of the density. In this way, the original complicated system is splitted into standard equations. This will be practical for computational procedures since it allows the choice of adapted discretizations for the separated problems. Two different types of transport equations are presented, one of them being based on a pseudo-transient interpretation of the equation of continuity. Its solvability is automatically ensured, no smallness assumption has to be imposed on the velocity field. In any case, the resulting convergence theorem requires an assumption that the data is sufficiently small. However, the schemes which are based on the pseudo-transient transport equation should perform much better in numerical computations and may actually converge for relatively large data. The solutions that are obtained by the iteration processes are shown to be locally unique. The analysis presented here is based on estimates for the velocity and density in $W^{3,2} \times W^{2,2}$.