Nonuniqueness of admissible weak solutions to the compressible Euler equations with smooth initial data

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Abstract

We consider the isentropic Euler equations of gas dynamics in the whole two-dimensional space and we prove the existence of a smooth initial data which admit infinitely many bounded admissible weak solutions. Taking advantage of the relation between smooth solutions to the Euler system and to Burgers equation we construct a smooth compression wave which collapses into a perturbed Riemann state at some time instant $T > 0$. In order to continue the solution after the formation of the discontinuity, we apply the theory developed by De Lellis and Szekelyhidi in order to construct infinitely many solutions. We introduce the notion of an admissible generalized fan subsolution to be able to handle data which are not piecewise constant and we reduce the argument to the finding of a single generalized subsolution.