Regular Reflection of Weak Shocks: A Global Existence Result

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When a supersonic shock wave hits a corner of a wedge, a reflected wave forms. For certain values of the Mach number and wedge angles the reflected wave meets the incident shock at a point on the wedge forming the "regular reflection" wave pattern. Depending on the parameters in the problem the flow behind the reflected wave in regular reflection can be either (a) subsonic everywhere, or (b) there is a region of supersonic flow located behind the reflected wave near the wall.

We study existence and stability of these two patterns in the situations when the incident shock is weak and the wedge angle is small. The corresponding asymptotic equations that govern the flow are the two-dimensional Burgers equations or the unsteady transonic small disturbance equations, valid in a bounded region near the foot of the incident shock. We prove the existence of a global solution in each case (a) and (b). We note that although the reduced equations have an unbounded subsonic region (which is an artefact of the asymptotic reduction), our proof holds only in a finite (not small), bounded region around the foot of the incident shock (where the reduced equations are valid). The existence proof is based on the study of a free-boundary problem for a (degenerate) quasilinear elliptic equation. Main ideas of the proof (based on the elliptic regularization and compactness arguments) will be presented.

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