Exact Riemann solutions to compressible Euler equations in ducts with discontinuous cross–section

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We determine completely the exact Riemann solutions for the system of Euler equations in a duct with discontinuous varying cross–section. The crucial point in solving the Riemann problem for hyperbolic system is the construction of the wave curves. To address the difficulty in the construction due to the nonstrict hyperbolicity of the underlying system, we introduce the L–M and R–M curves in the velocity–pressure phase plane. The behaviors of the L–M and R–M curves for six basic cases are fully analyzed. We observe that in certain cases the L–M and R–M curves contain the bifurcation which leads to the non–uniqueness of the Riemann solutions. The physically relevant solution is singled out among all the possible exact solutions by comparing them with the numerical results of the axisymmetric Euler equation model.

References

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