

## Structure of Sonic Booms in a Medium with Multiple Relaxation Modes

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The shock structure of a sonic boom is controlled by the balance between nonlinearity and dissipation/dispersion mechanisms. In the atmosphere relaxation modes associated with nitrogen and oxygen molecules are important as well as viscosity. For realistic parameter values, these effects occur on different scales making asymptotic analysis possible. In this paper, numerical and asymptotic results are presented first for travelling wave solutions and then for disturbances evolving from an initial N-wave form. It is found that structure of the shock can be particularly intricate with the possibility of two sub-shocks embedded within the main shock. This change in shock structure leads to the appearance of different length scales, important when assessing the annoyance of a sonic boom. It is shown that numerics alone prove impractical due to the need to resolve three different lengthscales within the shock, while in some cases the asymptotic analysis must be supplemented by numeric solutions of the disturbance outside the shock region.

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