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Solitons on the rarefaction wave background via the Darboux transformation

Rarefaction waves and dispersive shock waves are generated from the step-like initial data in many nonlinear evolution equations including the classical example of the Korteweg-de Vries (KdV) equation. When a solitary wave is injected on the step-like initial data, it is either transmitted over or trapped inside the rarefaction wave background. We show that the transmitted soliton can be obtained by using the Darboux transformation for the KdV equation. On the other hand, we show with the help of numerical simulations that the trapped soliton disappears in the long-time dynamics of the rarefaction wave.