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Steady solution of solitary waves in nonlinear shear current

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The main research presented here is obtaining the steady solution of solitary waves in nonlinear shear current. The strongly nonlinear wave model, the GN model is used. The GN model only introduces an assumption on the velocity variation in the vertical direction across the fluid sheet. The steady solution is obtained by the Newton-Raphson method. The profile of nonlinear shear current is described as a quadratic polynomial form. The converged results of the GN model on the wave speed and wave profile match the results of third-order solution by Pak and Chow (2009) well. The velocity field and vorticity field are also studied. When the height of solitary wave and the strength of opposing shear current (the direction of the shear current is opposing to the direction of the solitary wave propagating) are both large, an obvious vortex is found. It is found that along the water depth at wave crest, the vorticity changes nonlinearly. With the spatial position is further from the wave crest, the vorticity changes more linearly. This research is useful in understanding the interaction between solitary waves and nonlinear shear current.