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Hydraulic Jumps and Resonance in Gravity-Driven Flows of Liquid in Inclined Wavy Channels: Transition and Hysteresis

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We study the flow of a viscous liquid down an inclined channel with a sinusoidal bottom profile of moderate waviness. At low inclination angles, where basins form due to non-monotonous falling bottom slopes, we observe the formation of stationary hydraulic jumps in the form of shock fronts and surface rollers. There exists a bistable region in which both jump phenomena, shock fronts and surface rollers, can occur. At the low end of the bistable region, an instationary regime of a shock with a fingering-like lateral modulation is found. At higher volume flux and inclination angles, the hydraulic jump is suppressed by a standing wave that is generated by a resonance between gravity waves and the wavy bottom. At the transition between surface rollers and standing gravity-waves, periodic switching between the two occur.

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