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Linear stability analysis of flows in a grooved channel[1] ALIREZA MOHAMMADI, Princeton University, JERZY MACIEJ FLORYAN, University of Western Ontario — It is known that longitudinal grooves which are parallel to the flow direction may either stabilize or destabilize the travelling wave instability in a pressure-gradient-driven channel flow depending on the groove wave number. These waves reduce to the classical Tollmien-Schlichting (TS) waves in the smooth channel limit. It is shown that another class of travelling wave instability exists if grooves with sufficiently high amplitude and proper wavelengths are used. It is demonstrated that the new instability is driven by inviscid mechanisms, with the disturbance motion having the form of a wave propagating in the streamwise direction with the phase speed approximately four times larger than the TS wave speed and with its streamwise wavelength being approximately twice the spanwise groove wavelength. The instability motion is concentrated mostly in the middle of the channel and has a primarily planar character, i.e. the dominant velocity components are parallel to the walls. A significant reduction of the corresponding critical Reynolds number can be achieved by increasing the groove amplitude. This mode reduces to the highly attenuated Squire mode in the smooth channel limit.

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