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Control of the secondary crossflow instability: Direct numerical simulation of localized suction in three-dimensional boundary layers

By Tillmann Friederich

Shaker Verlag Aug 2013, 2013. Buch. Book Condition: Neu. Neuware - Transition control by localized 'pinpoint' suction in a three-dimensional boundary-layer flow with crossflow is investigated by means of direct numerical simulation. The control of large-amplitude steady crossflow vortices with active secondary instability constitutes hereby an alternative promising possibility to maintain laminar flow on relevant regions of airliner wings (active laminar flow control) resulting in a significant reduction of drag and thus also of greenhouse gas emissions. Up to date, laminar flow control applied to tackle crossflow instability aims at a reduction of the primary crossflow instability, i.e. hindering the development of large-amplitude, secondarily unstable crossflow vortices. The classically applied homogeneous suction focuses on reducing the crossflow in the quasi two-dimensional base flow which results in hindered growth of crossflow vortices, later-induced secondary instability and hence delayed laminar-turbulent transition. On the other hand, techniques like the 'distributed roughness elements' method or 'distributed flow deformation' excite locally stable or weakly unstable crossflow vortex modes, leading to 'benign' crossflow vortices that are spaced narrower than the naturally amplified ones while suppressing all other modes, including the most unstable ones. In the current work, the three-dimensional nonlinear disturbance state with large-amplitude steady...

Reviews

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