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Momentum balance in a transitional boundary layer O. RAMESH, P. DESAI, Indian Institute of Science — The mechanism of bypass transition at elevated turbulence levels is believed to be fundamentally different from the so-called canonical transition. We hypothesise that the difference between bypass and canonical transition should show up even in a gross balance as the momentum integral equation. Momentum integral equation for a zero pressure gradient boundary flow is $\frac{d\theta}{dx} = \frac{C_f}{2} - \frac{\partial}{\partial x}\int\limits_0^\infty \frac{\overline{v'^2 - u'^2}}{U^2}dy$. The last term is usually neglected except near separation. We argue that it may not be really negligible for transitional boundary layers under constant pressure as it is conceivable that the stream-wise velocity gradient of the turbulence quantities could be substantial at least for some increased values of free-stream turbulence levels. By conducting experiments in a constant pressure boundary layer, we find that the stream-wise derivative term involving turbulence quantities can be quite substantial at least near the initial part of the transition region. This is indicative of a different mechanism at work in bypass transition compared to canonical transition. One may speculate that bypass transition perhaps has a flavour of flow separation.This study also indicates that skin friction estimate in transitional boundary layer experiments using momentum balance should be carefully performed and use all the three terms shown above in the equation.

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