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Mesolayer analysis in a turbulent boundary layer and DNS data

NOOR AFZAL, Retired Aligarh University, Aligarh 202002, India — The intermediate layer (mesolayer) in turbulent boundary layer has been analysed by the matched asymptotic expansions where matching is implemented by Izakson-Millikan-Kolmogorov hypothesis. The large-scale motions and very large scale motion are modifying the influences of the outer geometries, and most significantly near the locus of the peak in shear stress in the mesolayer. The mesolayer is formed by the interaction of inner and outer layer scales, whose length (time) scale is the geometric mean of the inner and outer length (time) scales, and is also proportional to Taylor micro length (time) scale. The mesolayer variable is proportional to inverse square root of appropriate friction Reynolds number, provided Reynolds number is large. It is shown that the shape factor and Reynolds shear maxima scale with mesolayer scale equivalent to Taylor micro length scale. Further, the turbulent bursting time period scales is shown to mesolayer time scale which is equivalent to Taylor micro time scale. The implications of mesolayer on higher order effects on skin friction law for lower Reynolds number have also been analyzed. The implications of shift origin are proposed by the Prandtl's transposition theorem, and consequently without any closure model.

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