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Formation of Three-Dimensional Stall Cells on Two-Dimensional Airfoils VICTOR SIVANERI, BURAK TUNA, EDWARD DEMAURO, MICHAEL AMITAY, Rensselaer Polytechnic Institute — Stall cells are a pattern of three-dimensional mushroom-shaped structures that form within the separated region of stalled, thick airfoils within a certain range of Reynolds numbers. The occurrence and number of stall cells are dependent on the wing camber, aspect ratio, angle of attack, and Reynolds number. While much work within the literature has been conducted to visualize and measure this phenomenon, to date a comprehensive explanation for their existence remains elusive. The present work aims to identify these structures, quantify them, and understand the mechanisms by which they are formed. This was conducted using oil flow visualization and stereoscopic particle image velocimetry (SPIV) on a two-dimensional NACA 0015 airfoil, pitched to 18° angle of attack, at Reynolds numbers ranging from 160,000 to 400,000. Oil flow visualization was used to qualitatively identify the signature of the stall cells on the airfoil surface and resolve the associated skin friction vector fields. In addition, SPIV measurements were taken in order to quantify the flow field in the presence and absence of stall cells within the region of separated flow above the surface of the airfoil. Results showed that the stall cells are highly sensitive to Reynolds number, with evidence of an apparent bi-stable state existing at a Reynolds number of 320,000.

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