As modern gas turbines implement more and more complex geometry to increase life and efficiency, attention to unsteady aerodynamic behavior becomes more important. Computational optimization schemes are contributing to advanced geometries in order to reduce aerodynamic losses and increase the life of components. These advanced geometries are less representative of cylinder and backward facing steps which have been used as analogous geometries for most aerodynamic unsteadiness research. One region which contains a high degree of flow unsteadiness and a direct influence on engine performance is that of the MidFrame.

The MidFrame (or combustor-diffuser system) is the region encompassing the main gas path from the exit of the compressor to the inlet of the first stage turbine. This region contains myriad flow scenarios including diffusion, bluff bodies, direct impingement, high degree of streamline curvature, separated flow, and recirculation. This represents the most complex and diverse flow field in the entire engine. The role of the MidFrame is to redirect the flow from the compressor into the combustion system with minimal pressure loss while supplying high pressure air to the secondary air system. Various casing geometries, compressor exit diffuser shapes, and flow conditioning equipment have been tested to reduce pressure loss and increase uniformity entering the combustors.

Much of the current research in this area focuses on aero propulsion geometries with annular combustors or scaled models of the power generation geometries. Due to the complexity and size of the domain accessibility with physical probe measurements becomes challenging. The current work uses additional measurement techniques to measure flow unsteadiness in the domain. The methodology for identifying and quantifying the sources of unsteadiness are developed herein. Sensitivity of MidFrame unsteadiness to compressor exit conditions is shown for three different velocity profiles. The result is an extensive database of measurements which can serve as a benchmark for radical new designs to ensure that the unsteadiness levels do not supersede previous successful levels.

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The public is welcome to attend.