Modern propulsion systems primarily operate under highly turbulent conditions in order to promote greater efficiency through an increase in mixing. The focus of this thesis is to identify the turbulent flame-vortex interaction to provide insights into the turbulent combustion process. This work is accomplished through the use of turbulent ramjet-style combustor which is stabilized through use of a bluff-body. The facility is equipped with a custom turbulence generator to modulate the incoming turbulence levels to allow flames across various regimes to be analyzed. High-speed particle image velocimetry (PIV) and CH* chemiluminescence diagnostics are implemented to resolve the flow field and flame position. The flame-vortex interaction can be described by the vorticity transport which has four terms; vortex stretching, baroclinic torque, dilatation, and viscous diffusion. The vorticity mechanisms are calculated through the implementation of a Lagrangian tracking scheme, which allows for the individual mechanisms to be decomposed along the path of individual tracks. The mechanisms are compared across different turbulence levels to determine the effects of turbulence on the vorticity mechanisms. The mechanisms are calculated along the flame front as well to determine the individual effects of the vorticity mechanisms on the evolving structure of the turbulent remixed flame. The flame front curvature is also compared across the various turbulence conditions. The results confirm that as the flame-front experiences increased turbulence levels the combustion induced mechanisms of baroclinic torque and dilation decrease, while vortex stretching increases. This is a result of the turbulent energy exchange becoming the controlling factor within the flow-field. In addition, increased flame curvature is experience by the flame front due to increased local baroclinicity and turbulent energy exchange.

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The public is welcome to attend.