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Investigation of performance and mode transition in a variable divergence ratio dual-mode combustor

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Abstract: **To operate in a wide range of incoming flow Mach number, a variable divergence ratio dual-mode combustor is designed. Experimental and numerical investigation of the dual-mode combustor has been conducted in this paper. By regulating the divergence ratio in combustor, in a high incoming flow Mach number or low equivalence ratio, a small divergence ratio could increase pressure peak and boost combustor performance. Under a low flight Mach number or a high equivalence ratio, a large divergence ratio has a benefit to accommodate more heat release and prevent the inlet unstart. The results of experiments and numerical investigations have been testified that the variable divergence ratio dual-mode combustor could operate in a wide range of incoming flow Mach number. Another aspect, the combustor wall ramp makes an additional effect on the combustion zone. The combustion zone distribution is close to the upper wall because of the pressure differentials of the main flow aroused by lower wall ramp compressing acting on the supersonic airflow. Under the effecting of incoming flow Mach number and heat release, Mach number near the leading edge of the ramp decides the location of the combustion zone. Comparing with a common combustor, it is harder to form a thermal throat in the combustor because of the big divergence angle in the variable divergence ratio combustor. Based on the flow field analysis, a conclusion is drawn that the combustion mode transition is dominated by the combustion heat release in the variable divergence ratio dual-mode combustor configuration.**

Keyword: combustion mode transition, dual-mode combustor, variable divergence ratio combustor

Nomenclature

Ma	=	*Mach number*
h	=	*height of cross section*
η	=	*divergence angle*
θ	=	*compression angle*
φ	=	*equivalence ratio*
ξ	=	*divergence ratio*
k	=	*specific heat ratio*
A	=	*cross section area*
p	=	*static pressure*
T	=	*static temperature*
T^*	=	*total temperature*
C_f	=	*wall skin friction coefficient*
A_r	=	*pre-exponential collision frequency factor*
E_a	=	*activation energy*

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