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# Complex-network analysis of high-frequency combustion instability in a single element combustor for liquid rocket engines

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## Abstract

We study the network dynamics of high-frequency combustion instability in a model rocket engine combustor with a single element coaxial injector. We mainly adopt complex-network analysis: the turbulence network, the *P-Z* map, and the acoustic energy flux-based spatial network for spatiotemporal data obtained by a large eddy simulation. A scale-free topology clearly appears in the turbulence network during high-frequency combustion instability. The appearance of the scale-free topology is significantly associated with the promotion of the hydrodynamic shear layer instability in the recessed region due to the abrupt pressure fluctuations inside the hydrogen injector. The vortical structure in the recessed region, which promotes the mixing of fuel and oxidizer, has a significant impact on the driving of high-frequency combustion instability.

**Keywords: Liquid rocket engine, Combustion instability, Complex network**