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Secondary Forcing Of Flames with Electric Fields

Feedback-controlled electric fields cut peak combustion pressures ~30× to improve efficiency.

Researchers at Purdue University have developed a method for feedback control of flames via electric fields. This work builds upon 2023-KING-70043 by targeting flame pinch-off and pocket formation to further reduce instabilities and improve combustion emissions. When used with the previously developed hardware, this system consumes negligible additional power while reducing the peak pressure by an additional 8x. With a lower peak pressure, leaner air-fuel mixtures can be used to enable cost and emissions reductions. Possible applications of this technology include industries that use continuous combustion processes with gaseous fuels and are looking to reduce emissions. Examples include gas turbines for electricity generation, residential devices (boilers, furnaces), and industrial devices (furnaces, boilers).

Advantages

- Cost-effective way to improve flame stability

- Enables use of green fuels and leaner air-fuel mixtures

- NOx emissions reductions

- Noise reductions

Applications

- Power generation

- Residential heating

- Industrial processes

Technology Validation:

Technology ID
2024-CRUI-70337

Category
Aerospace & Defense/Thermal Management & Combustion Optimization
Semiconductors/Devices & Components

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This technology has been validated through testing of the control signal with hardware from previous technology (2023-KING-70043). Results showed an 8x reduction in peak pressure amplitude, on top of a 22x reduction provided by the work from the previous method.

Related Publications:

Dustin L. Cruise, Aman Satija, and Galen B. King. "Thermoacoustic Instability Suppression and Heat-Release Forcing of a Laminar Flame Using Ionic Wind". arXiv preprint arXiv:2309.00094 (2023)

Dustin L. Cruise, Aman Satija, and Galen King. "Suppression of Thermoacoustic Instabilities Using an Electric Field and Feedback Control," AIAA 2023-0556. AIAA SCITECH 2023 Forum. January 2023.

TRL: 5

Intellectual Property:

Provisional-Patent, 2023-07-20, United States

Utility Patent, 2024-07-16, United States

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