



DOCTORAL RESEARCH TOPIC:

Enhancing jet propulsion efficiency using non-thermal plasma technology

RESEARCH FIELD:

Energetics and Power Engineering (T 006)

BRIEF DESCRIPTION OF RESEARCH TOPIC:

Due to rapidly growing globalization over the past two decades, the number of commercial and private flights, as well as artificial satellite launches, has been increasing exponentially. This trend is closely linked to the global consumption of fossil fuels. It is estimated that aviation emits around 880 million tons of CO₂ per year, contributing significantly to climate change. Jet engines are particularly sensitive to fuel type diversification therefore, their substitution with more sustainable, renewable biofuels is still under development. While improving jet engine efficiency can reduce fuel consumption and CO₂ emissions, these engines have nearly reached their maximum performance potential. Consequently, further advancement requires exploring and investigating alternative technologies.

A possible solution involves the use of non-thermal plasma technology, which can accelerate oxidation reactions, promote the formation of reactive radicals, and enhance combustion zone activity. Plasma effects can be applied to improve the interaction efficiency between fuel and/or oxidizer, as well as to increase combustion completeness. Properly optimised parameters may increase the specific impulse (efficiency) of jet engines, improve thrust characteristics, reduce fuel consumption and CO₂ emissions, and ensure more stable combustion.

The scientific problem of this research lies in the insufficient understanding of the mechanisms through which non-thermal plasma affects thermochemical conversion, combustion rate, thrust generation, efficiency, and combustion stability in jet propulsion systems.

The scientific objective of this study is to identify possibilities for improving jet propulsion efficiency through the application of non-thermal plasma technology. The research will examine the thermal conversion of fuel under various combustion conditions, its influence on thrust generation, pressure dynamics, temperature, and overall system efficiency. Experimental results will allow the identification of optimal parameters for plasma-assisted combustion processes.

Potential research topics within this field include:

- Investigation of jet propulsion efficiency enhancement using non-thermal plasma technology
- Study of hydrogen combustion stabilisation by plasma in supersonic flow
- Influence of non-thermal plasma on ammonia combustion processes

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