



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكرو فيلم

بسم الله الرحمن الرحيم



HANAA ALY



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شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



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EXPERIMENTAL INVESTIGATION OF TURBULENT PLANAR INHOMOGENEOUS JET FLAMES USING RAYLEIGH SCATTERING TECHNIQUE

By

Bassem Mohamed Akoush Abdelmohsen

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
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Title of Thesis:

Experimental investigation of turbulent planar inhomogeneous jet flames using Rayleigh scattering technique

Key Words:

Inhomogeneous; Mixing field; Stability; Regime diagram; Rayleigh scattering

Summary:

The objective of this work is to study the mixing field of inhomogeneous jets flames using highly resolved measurements of non-reacting free jets of air and fuel in a concentric flow slot burner, CFSB, using Rayleigh scattering technique. The impact of the mixing length, equivalence ratio, Reynolds number, velocity ratio between the air and the fuel and the fuel type on the mixing field were investigated. The data are then analyzed statistically and classified using the regime diagram of partially premixed flames. The stability characteristics of inhomogeneous jet flames are studied experimentally at different velocities of co-flow air. The aim is to study the correlation between the mixing field structure and flames stability. This work provides a massive dataset with high quality for the mixing field of inhomogeneous jet flames which can be used in numerical modeling of these flames in the future.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

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Nomenclature

Latin

Symbol	Description
A	Cross-section area of flow
D	Hydraulic Diameter
dZ/dl	Two-dimensional gradients of the mixture fraction
fl	Focal length
$(F/A)_{st}$	Stoichiometric fuel to air ratio
F/A	Actual fuel to air ratio
I_{Laser}	Laser energy
$(L/D)_{max}$	Maximum limit of L/D for stable flames
$(L/D)_{min}$	Minimum limit of L/D for stable flames
L	Mixing length
m	Number of carbon atoms
$\dot{m}$	Mass flow rate
MW	Molecular weight
n	Number of hydrogen atoms
Re	Reynolds number
U	Stream velocity of fluid
Z	Mass Mixture Fraction
N	Total molecular number density
R_{Δ}	The normalized range of mixture fraction, the ratio between ΔZ and ΔZ_{LR}
R_Z	The normalized mean of mixture fraction, the ratio between Z_{mm} and Z_{LR}
$S_{Rayleigh}$	Rayleigh scattering intensity
V_{cF}	Velocity of co-flow
Z_L	Mixture fraction at lean flammability limit
Z_{LR}	Arithmetic mean of the flammability limits mixture fraction
Z_R	Mixture fraction at rich flammability limit
Z_{max}	Maximum mixture fraction
Z_{min}	Minimum mixture fraction
Z_{mm}	Arithmetic mean of the min and max mixture fraction