

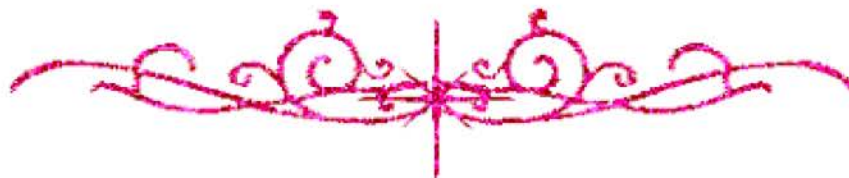
# بسم الله الرحمن الرحيم



**HOSSAM MAGHRABY**



# شبكة المعلومات الجامعية التوثيق الالكتروني والميكرو فيلم



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# جامعة عين شمس

## التوثيق الإلكتروني والميكروفيلم

### قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها  
على هذه الأقراص المدمجة قد أعدت دون أية تغيرات



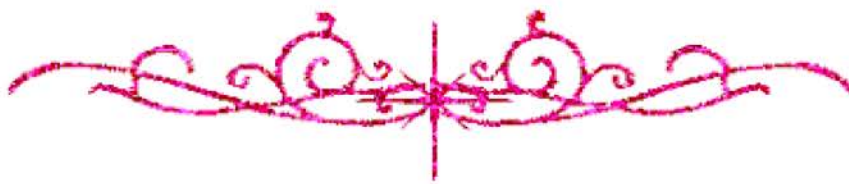
## يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

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# بعض الوثائق الأصلية تالفة



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بالرسالة صفحات

لم ترد بالأصل



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*Mathematical Imaging of Nonpremixed  
Methane-Air Flames*

B1234

BY

*Eng. Amr Mohamed Ali El-Azhary*

A Thesis Submitted To The  
Faculty of Engineering, Cairo University  
in Partial Fulfillment of the Requirements for the Degree of  
MASTER OF SCIENCE  
in Mechanical Power Engineering

Faculty of Engineering  
Cairo University  
Giza, Egypt

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Under the Supervision of

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## Abstract

Through the present work a new concept of a flamelet modeling is taken into consideration. Where the physical 2-D space was transformed to Two-dimensional space where the mixture fraction and reaction progress variable are taken as coordinates in this space instead of the old concept of the very thin flamelet where the two-dimensional physical space was transformed to one-dimensional space where the mixture fraction or the reaction progress variable is taken as a coordinate in this space. The most important gain in this transformation is that each point in the physical space is equivalent to a point in transformed space instead of a contour in the old transformation.

Numerical scheme using UPWIND method with the help of MATLAB as a programming tool is adopted where a new code was written right from scratch to solve the present problem. Four-step kinetic mechanism by *N.Peters [1]* is used to get the distribution field of oxygen, carbon monoxide, water vapor, hydrogen radical, hydrogen molecule, and fuel, which is natural gas in the present work. Energy equation is adopted in the present work to calculate the temperature field as one of the dependent variables. The radiation effect in the present work is neglect.

The study shows the significant effect of the stretching rate in the two-dimensional transformed space, where the heat transfers form a surface area rather than thin sheet [2]. This effect reflects on the value of the stretching rate at which the flame reaches the extinction limit. In the present study the flame reaches the extinction limit at a stretching rate equals  $7.5 \text{ s}^{-1}$  while the flame reaches the extinction limit at a stretching rate  $18 \text{ s}^{-1}$  in the previous thin flamelet studies.

Finally, the present work can be considered as a extension for the two variable approach, where it takes into consideration some flame features which were neglected by *Janicka and Kollmann[3]*.



## Acknowledgement

I whole-heartedly acknowledge the efforts of Prof Dr. M. M. M. Abou-Ellail, my M.Sc supervisor, his encouragement and constructive criticism throughout the course of the research served as a constant source of inspiration. I believe that his (very) patient disposition is possibly his finest attribute, and I have benefited considerably from the many discussions that we have had.

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Last (but definitely not least) I present my most sincere thanks to my family: Ahmad (and Reham). In the case of my parents, for fear of trivializing their contribution any further through set of clichés, I will simply point out that I will never forget your efforts. I dedicate my thesis to you both.

*Amr El-Azhary*



