بِسمِ اللهِ الرَّحمَنِ الرَّحِيمِ

الأيـــــــة

{اللَّهُ نُورُ السَّمَاوَاتِ وَالْأَرْضِ مَثَلُ نُورِهِ كَمِشْكَاةٍ فِيهَا مِصْبَاحٌ الْمِصْبَاحُ فِي زُجَاجَةٍ الزُّجَاجَةُ كَأَنَّهَا كَوْكَبٌ دُرِّيٌّ يُوقَدُ مِن شَجَرَةٍ مُّبَارَكَةٍ زَيْتُونِةٍ لَّا شَرْقِيَّةٍ وَلَا غَرْبِيَّةٍ يَكَادُ زَيْتُهَا يُضِيءُ وَلَوْ لَمْ تَمْسَسْهُ نَارٌ نُّورٌ عَلَى نُورٍ يَهْدِي اللَّهُ لِنُورِهِ مَن يَشَاءُ وَيَضْرِبُ اللَّهُ الْأَمْثَالَ لِلنَّاسِ وَاللَّهُ بِكُلِّ شَيْءٍ عَلِيمٌ }

صَدقَ اللهُ العظيم . سورة النور الآية35

DEDICATION:

I dedicate this research with love and respect to my teacher.

Also I dedicate it to the person who gives me the meaning of my life by her tender love, gentle touch and wonderful smile my mother. And to my Classmates, Friends, and everybody helped us to successes this project.

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First and foremost, we would like to thank the chairman of our department, Dr. SKHAR ABU DARG for his support, outstanding guidance and encouragement throughout our senior project.

We would also like to express our gratitude and appreciation to Dr. SKHAR for all the help and guidance he provided throughout our education, and to the other members of our instructors.

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Abstract:

A performance model for W1 Whittle Engine using the simulation program (GESTPAN), General Stationary and Transient Propulsion Analysis, has been developed. There are different optimization methods used by the simulation tool, such as GA (Genetic Algorithm), SQP (Sequential Quadratic Programming) and recently LM (Levenberg Marqurardt) has been added. The system uses measured data to tune a general model to engine parameters.

The performance of the engine at one design point is calculated analytically and then the performance of the engine at off-design points is analyzed numerically by using the in-house software GESTPAN.

To validate the program, the results are compared with the result of the thermodynamic design point.

The measured parameters used for the modeling are: the exit temperature and the thrust required with the rotational speed.

It is found that the error between the calculated data and the actual data is increased with the rotational speed while this error is decreased between the modeled results obtained by GESTPAN software and the actual results.

المستخلص:

يهدف هذا البحث لعمل وتطوير نموذج لأداء محرك توربيني نفاث (W1) بأستخدام برنامج محاكاة (GESTPAN). يعمل هذا البرنامج علي تحليل بيانات المحرك باستخدم طرق مختلفه لتحقيق الافضليه مثل طريقه (GA) و (SQP) وتم اضافه طريقه (LM) مؤخرا.

يستخدم هذا البرنامج لتحسين بيانات المحرك المقاسه في نقطة التصميم مع بارمترات نموذج المحرك التوربيني .

حُسِبَ اداء المحرك تحليلياً لنقطة تصميم واحدة , ثُم تم تحليل أداء المحرك عند عِدة نقاط خارج نقطة التصميم عددياً بإستخدام (GESTPAN) .

للتحقق من صحة أداء البرنامج، تم مقارنة نتائج البرنامج مع نتيجة نقاط التصميم المحسبة تحليلياً.

البرامترات المستخدمة لأداء نموذج هذا المحرك هي: درجة حرارة الخروج (T_{o4}) ودفع المحرك (Tr) مع سرعة دوران المحرك(RPM).

وجد أن الخطأ بين البيانات المحسوبة والبيانات الفعلية تزداد مع سرعة دوران المحرك حسابياً. بينما إنخفض هذا الخطأ للنتائج التي تم الحصول عليها من قبل برنامج (GESTPAN).

List of Content:

LIST OF FIGURE

List of symbol:

Symbol	Meaning
A_5	Nozzle area (m^2)
C_5	Nozzle velocity (m/s)
c_a	Air velocity (m/s)
cp_a	Specific heat of air (J/kg)
Cpg	Specific heat of gas (J/kg)
D	Tip diameter (m^2)
F	Fuel/air ratio
Fs	Specific thrust ($N.s/kg$)
$\dot{m}$	Mass flow rate (kg/s)
N	Maximum speed (rpm)
p_5	Nozzle pressure (bar)
p_a	Ambient pressure (bar)
p_r	Critical pressure ratio
p_{o1}	Intake pressure (bar)
p_{o2}	Inlet compressor pressure (bar)
p_{o3}	Inlet turbine pressure (bar)
p_{o4}	Outlet turbine (bar)
R	Constant for ideal gas (J/kg)
r	Pressure ratio

SFC	The specific fuel consumption
T_5	Nozzle temperature (k)
T_a	Ambient temperature (k)
Tc	Critical temperature (k)
Tr	Thrust (N)
T_{o1}	Inlet temperature (k)
T_{o2}	Inlet compressor temperature (k)
T_{o3}	Turbine inlet temperature (k)
T_{o4}	Turbine outlet efficiency (k)
$\acute{T}_{o4}$	Combustion temperature (k)
Δp	Combustion pressure losses
γ_a	Gama of air
γ_x	Gama of gas
ρ_5	Air density (kg/m^3)
Σ	Slip factor
η_c	Compressor isentropic efficiency
η_e	Mechanical efficiency
ηt	Turbine isentropic efficiency
ηn	of propelling nozzle efficiency
ηb	Burner efficiency