

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

الآية

{اللَّهُ نُورُ السَّمَاوَاتِ وَالْأَرْضِ مِثْلُ نُورِهِ كَمِشْكَاةٍ فِيهَا مِصْبَاحٌ الْمِصْبَاحُ فِي زُجَاجَةٍ الزُّجَاجَةُ كَأَنَّهَا
كَوْكَبٌ دُرِّيٌّ يُوقَدُ مِنْ شَجَرَةٍ مُبَارَكَةٍ زَيْتُونَةٍ لَا شَرْقِيَّةٍ وَلَا غَرْبِيَّةٍ يَكَادُ زَيْتُهَا يُضِيءُ وَلَوْ لَمْ تَمْسَسْهُ نَارٌ
نُورٌ عَلَى نُورٍ يَهْدِي اللَّهُ لِنُورِهِ مَنْ يَشَاءُ وَيَضْرِبُ اللَّهُ الْأَمْثَالَ لِلنَّاسِ وَاللَّهُ بِكُلِّ شَيْءٍ عَلِيمٌ }

صَدَقَ اللَّهُ الْعَظِيمُ . سورة النور الآية 35

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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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 Marquardt) 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 بأستخدم طرق مختلفه لتحقيق الافضليه مثل طريقه (GA) و (SQP) وتم اضافته طريقه (LM) مؤخراً.

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

حُسِبَ أداء المحرك تحليلياً لنقطة تصميم واحدة , ثم تم تحليل أداء المحرك عند عدة نقاط خارج نقطة التصميم عددياً بأستخدام (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_{04}) 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).

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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
F_s	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)
T_c	Critical temperature (k)
T_r	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)
\hat{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
η_t	Turbine isentropic efficiency
η_n	of propelling nozzle efficiency
η_b	Burner efficiency