

الآية

بسم الله الرحمن الرحيم

قال الله تعالى:

"شهد الله أنه لا إله إلا هو
و الملائكة و أولوا العلم
قائما بالقسط لا إله إلا هو
العزیز الحکیم"

صدق الله العظيم.

Dedication

We would like to dedicate this project

To those who gave our life its meaning

And taste

OUR FAMILIES

AERONAUTICAL DEPARTMENT.

Acknowledgement

We would like to thanks to those assist us to accomplish this

Project, firstly:

Faithful project supervisors:

ENG.D.Enisar Abdel Fattah

Secondly.

ANY ONE HELPS US.

المستخلص:

يدعم المشروع دراسة عدم الاستقرار الذي يحدث عند تشغيل مدخل الهواء فوق الصوتي في الظروف غير التصميمية (حالة الطيران و حالة المحرك أثناء التشغيل) وعندما يعمل المدخل بالقرب من النظام الحرج (critical) فإن استقراره يضطرب بسبب عملية إنتقالية عابرة تحدث بسبب نقصان كمية الهواء التي يتطلبها المحرك وبسبب تتداخل الصدمات مع الطبقة المتاخمة (boundary layer). هذه الظاهرة تحدث بسبب حالة الطيران (Mach number) وكما هو معروف بالأزيز (buzz). وعندما تتجاوز كمية الهواء المخزون الكمية التي يتطلبها المحرك تدفع الصدمة العمودية (normal shock) من المدخل الي الخارج. وهذه الظاهرة تحدث بسبب (حالة تشغيل المحرك) وهي المعروفة بالإختناق (surge)

للحصول علي التصميم الأمثل يتم بواسطة حساب أفضل قيمة لنسبة الضغط الركودي (pressure recovery) (total)، وتحسب أبعاد المدخل من حيث نسبة إلى قطر وجه المحرك. للحصول علي أمثل نظام يتم استخدام عدة صدمات مائلة (N-1) ذات الشدة المتساوية مع صدمة عمودية واحدة وذلك لقليل الخسارة و يتم الحصول على أقصى قدر من (pressure recovery). ، ويتم حسابه أيضاً في الظروف الخارجة عن نطاق التصميم حتى يتم معرفة أداء المحرك في هذه الظروف. كما يتضمن المشروع الطرق المكتشفة للحد من هذه الظواهر وحلها. وهذه الطرق تؤدي لتوافق كمية الهواء الداخلة مع طلب المحرك مثل the second ramp angle والمرر الهواء الجانبي open/close schedule of a bypass door

Abstract:

The project provides study of instability which occurs when supersonic inlet operation at off design conditions (flight condition and engine operation condition). When the inlet operate near to critical regime, the stability interrupted by transient process which occur due to reduce of mass flow required by the engine and boundary layer interaction with shock system. This phenomenon occurs due to flight condition and it is known as buzz. Also when mass flow store inside inlet exceed than mass demand by the engine, the normal shock will expelled out of inlet. This phenomenon occurs due to (engine operation condition) and it is known as surge.

For an on-design condition, the total pressure recovery is maximized according to the optimization criterion, and the dimensions of the inlet in terms of ratios to the engine face diameter are calculated. The optimization criterion is defined such that in a system of $(n-1)$ oblique shocks and one normal shock in two dimensions, the maximum shock pressure recovery is obtained when the shocks are of equal strength. This project also provides a method to estimate the total pressure recovery for an off-design condition for the specified inlet configuration. For an off-design condition, conservative estimation of the total pressure recovery is given so that performance of the engine at the off-design condition can be estimated. Also the project includes the methods discovered to reduce and solve these phenomenons. This methods lead to match the mass flow demand of the engine, the second ramp angle is adjusted and the open/close schedule of a bypass door is determined.

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List of Samples:

Sample	Definition
M_{in}	Strength of the shock
θ_i	Angle of shock wave
δ_i	Deflection angle or half wedge angle
a	Speed of sound
P_{oi}	Stagnation pressure
A^*	Critical area(throat area)
A_e	Exit area of diffuser
P_e	Back pressure
M_e	Exit Mach number
x	Up stream of normal shock
y	Downstream of normal shock
M_{dc}	Mach number at design condition
T_{oi}	Stagnation temperature
T_i	Static temperature
P_i	Static pressure
K	Specific heat constant
R	Specific gas constant
i	Number of shock
V	Flight speed
$\dot{m}$	Mass flow rate
ρ	Density
o	Stagnation state

List of abbreviations:

TPR	Total pressure recovery
CFD	Computational fluid dynamics
DC	Design condition