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Dynamics Parameter' Graphs of Passenger Planes

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Abstract : Passenger plane flying motion graphics is very important for route, control of the flight altitude and passenger safety. For all that, it is quite useful for route away from the disruptive influences such as vibrations caused by storms or turbulence during the flight and in processes such as re-arrest of the specified route. Therefore, the response time against the adverse effects of the shape and the system is so necessary for both safety and comfort. In this study motion and route graphics were obtained under the control of an airliner C # interface with the program. In this way, graphics were obtained in solving the equations of motion in short time and design time was shortened.

Key Words : Flying safety, Passenger safety, Flying graphics, Turbulence effect, Route keeping

1.Introduction

Excess of the parameters that affect the performance of an aircraft, comprehensive performance analysis makes a time-consuming process. Therefore, studies on the calculation of the aircraft's flight performance and performance optimizations can be made more useful using software. This performance analysis, test whether the success of the car's design goals, the consequence of the mission profiles re-adaptation or expansion and it essential for issues such as a new aircraft design [1-2-3-4-5-6].

In the Prioroc and Mikkola's work, two aircraft have used numerical methods for calculation of relative motion. Thus, the state can be researched using a widely formulation and linearized approach. So analytical solutions can be derived for variational equations of motion of two celestial bodies. J2 problem of relative movement of the two satellites, secular variations of the orbit can be solved using J2ME theory is a useful approach. Numerical methods results were compared of produced approach based on the two mass variable but workable approach. As a result, a good solution was found for same curved semi-circular orbits [2-7].

Air temperature decrease when rise from the ground. Layer of the atmosphere up to 11 km altitude above sea level is

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troposphere. Square of the speed of sound changes of directly proportional with air temperature. For this reason, Mach number at that altitude is less than sea level Mach number. This work describes the design of an improved program performance in order to speed up the analysis process.

Below mentioned that in Table 1, all used parameters and their descriptions are given. All used formulas are respectively described and obtained.

Table. 1 Symbols and Definitions

Symbol	**Description**
W	Aircraft Weight
V	Aircraft Real Air Speed
D	Flight Trajectory Parallel Friction and Transport Force
L	Flight Trajectory Vertical Friction and Transport Force
T	Thrust Vector
ε	The angle between the aircraft reference line and thrust
a	Angle of attack
ɣ1	Roll angle between the lateral axis of the aircraft and the plane of the orbit
ɣ2	Flight Trajectory angle between Flight Trajectory and the horizontal plane
ɣ3	Track angle or the Direction angle of the aircraft for symmetric flight state
P	Shaft power
η	Propeller efficiency
C_D	Drag coefficient
$C_{D,0}$	Zero Drag coefficient
K	Induced Drag coefficient
C_L	Transport coefficients
σ	Altitude
p	Static pressure
ρ	density
R	Gas Constant
Ti	Temperature
H	Height
L	Temperature Gradient
i index	The initial height of the sheet equation calculated
R	Aircraft Range
TSFC	Propulsion fuel consumption

2. Flight Formulation

Motion equations based on the particle adoption of aircraft is Newton's (F=d(mV)/dt) speed axes adapted (Fig 1). That is accepted the earth is flat and symmetrical flight state;

$$\begin{aligned} &+Tcos(a+\varepsilon)-Wsin\gamma 2=m\dot{V} \\ &Lsin\gamma 1+Tsin(a+\varepsilon)\sin\gamma 1=mV\gamma 3\cos\gamma 2 \\ &-Lcos\gamma 1-Tsin(a+\varepsilon)\cos\gamma 1+Wcos\gamma 2=-mV\gamma 2 \end{aligned} \tag{1}$$

Above equation is written for according to the producing thrust propulsion aircraft system. The connection between power and propulsion power generating drive system for aircraft;

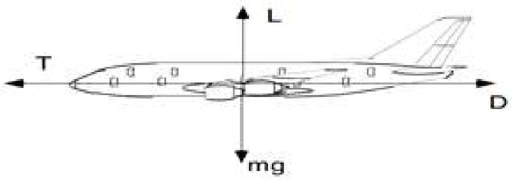

Fig. 1 Forces Affecting to Airplane

$$\eta \quad TV \tag{2}$$

With the necessary adaptations to be made to the equations of motion; cruise, climb, descent and maneuvers can be solved. Point-performance parameters and orbit performance are calculated using analytical and numerical solutions of equations of motion for aircraft cruise, climb, descent and maneuvers stations. The aerodynamic and propulsion characteristics and the creation of atmosphere model must for calculating flight performance. Aircraft aerodynamic model, are represented by two different dragging polar for subsonic and supersonic flight performance calculations. In the usual dragging polar for subsonic flight, the drag coefficient is a parabolic function of the transport coefficients.

$$C_{D,0)} + KC_L^2 \tag{3}$$

For supersonic flight, the drag coefficient depends on angle of attack a parabolic equation usual polar is used. Where all coefficients are a function of the Mach number (CD,0(M), K(M), CLa(M)).

$$C_D = C_{(D,0)} + KC_{(L\ )}\alpha^2 \tag{4}$$

Some approaches made terms of drive system for performance calculations, performance calculations can simplify for some flight states. For impulse generating systems, which is independent of the speed of the impulse (such as turbojets) are approaches are independent of the response to the specific fuel consumption of altitude and speed. Similar assumptions can be made for generating power drive systems. The thrust change with altitude;

$$\frac{T}{T^*} = \left(\frac{\sigma}{\sigma^*}\right)^X \tag{5}$$

Where "*" specifies the conditions of troposphere limit (11000). x, depending on the drive system can be expressed as follows;

$$\begin{array}{ll} \le 11000m & 0.5(turbojet) \le x \le 0.9(turbofan) \\ h > 11000m & x = 1 \end{array}$$

In our program the value of x is taken as the average value of 0.7. Power changing according to altitude in the power generating drives systems;

$$\frac{P}{L} = \begin{array}{ll} \sigma^{.765} & h \le 11000m \\ 1.331\sigma & h > 11000m \end{array} \tag{6}$$

Sea-level power can be maintained up to a critical height for supercharged piston engine and fixed rate turboprop. Therefore, the following approach has been applied for this system;

$$\frac{P}{P_{SL}} = \begin{cases} 1.0 & h \le h_{critical} \\ \left(\frac{\sigma}{\sigma_{critical}}\right)^{0.765} & h_{critical} < h \le 11000m \\ \frac{1.331\sigma}{\sigma_{critical}^{0.765}} & h > 11000m \end{cases} \tag{7}$$

The air is perfect gas according to ISA model and equation of state;

$$p = \rho RT \tag{8}$$

Where, R is the gas constant 287.05287 J / kgK d. Also standard atmosphere;

$$\begin{array}{l} p_0 = 101325N/m^2 \\ T_0 = 288.15K \\ \rho_0 = 1.225kg/m^2 \end{array} \tag{9}$$

Pressure, temperature and density values are used. Changes temperature in standard atmosphere;

$$T = T_i + L_i(H - H_i) \tag{10}$$

Temperature gradient L is a constant value in each layer. i index is the initial height of the layer equation is calculated. For troposphere 0, respectively 11 and 20 are taken to underlayer and intermediate stratosphere. These values;

$$\begin{aligned} &-0.00650K/m \\ L_{11} &= 0K/m \\ L_{20} &= 0.001K/m \end{aligned} \qquad (11)$$

The state equation of change of the pressure according to height and the equation for the hydrostatic pressure gradient is obtained by the joint solution;

$$\frac{\delta p}{p} = -\frac{g_0 \rho}{R[T_i + L_i(H - H_i)]}\delta H \qquad (12)$$

The connection between pressure and altitude using Integration of the results of the atmospheric layers of the equation;

$$p = p_i\left[1 + \frac{L_i}{T_i}(H - H_i)\right]^{\frac{g_0}{L}}; L \neq 0 \qquad (13)$$

$$p = p_i \exp\left[-\frac{g_0}{RT_i}(H - H_i)\right]; L = 0 \qquad (14)$$

as is obtained. Mach number is a dimensionless quantity representing the ratio of speed of an object moving through a fluid and the local speed of sound. For example, 1 Mach= 1226.5 km / h (340 m / sec) is indicated at 1 atm sea level pressure and 15 ° C air temperature. Mach number is very important for aircraft analysis. SAR is a measure of the fuel factor. In this context, a lot of aircraft technical information contained in the document SAR-Mach number of aircraft using graphing reviews.

$$R = \left(\frac{V}{TSFC}\right)\left(\frac{L}{D}\right)\ln\left(\frac{w_i}{w_f}\right) \qquad (15)$$

Above equation is given Breguet Range equation.

3. Software

This software GAZI UNIVERSITY APARTMENT PRESIDENCY OF INFORMATION PROCESSING licensed by Visual Studio 2012 program has been developed in c # language. This program will be available for different airplanes and the values entered by the different flight conditions on the results of any flight conditions of any aircraft and graphics of any flight conditions of any aircraft. For example, Mach number of Boeing 777 is 0.80 for using Pratt & Whitney PW 4086 engines have 2 engine at variable altitude (7000-11000feet) and average sea level to high 11000m. If the engine provides 15000lb thrust, average hourly fuel consumption will 15000lb * 0.6lb / hr / lb = 9000lb. This is the amount of consumption per engine for one hour.

AR = 8.5 (aspect ratio), S=420 m2, TSFC = 0.6 N/h/N, mass at starting climb (TOC) = 224,000 kg, mass at starting descent (TOD) = 178,000 kg, attitude=11,000 m., wind coefficient factor=0.83. The output of the program is seen in Fig 3, Fig4, Fig 5 and Fig 6. In addition program interface is shown with Fig 7

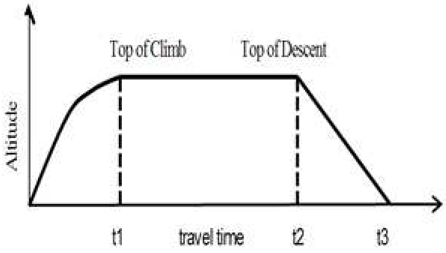

Fig. 2 Aircraft Climb-Route-Descent Movement Graphics

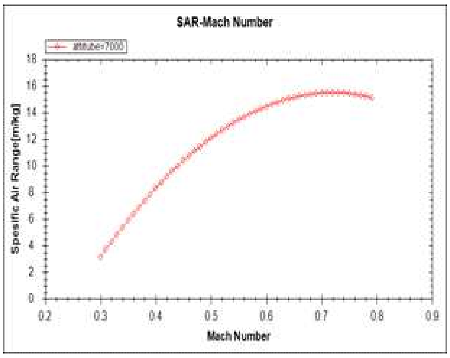

Fig. 3 SAR-Mach Number Graph

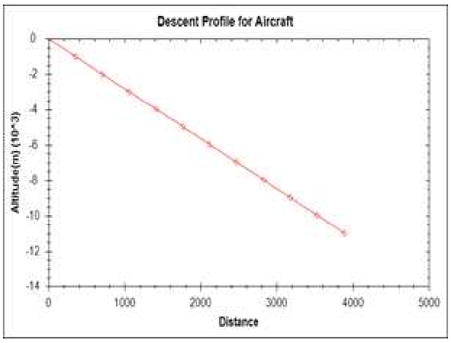

Fig. 4 Descent Time Based On Altitude

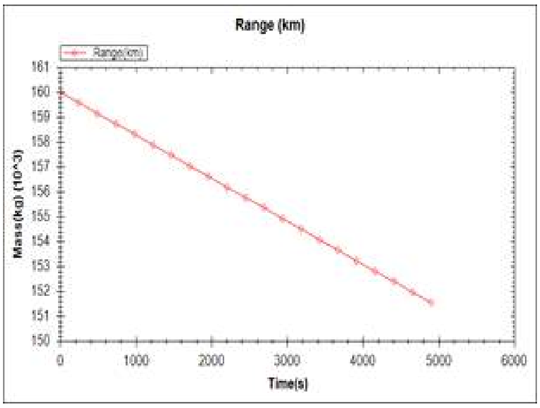

Fig. 5 Fuel Consumption Based On Time

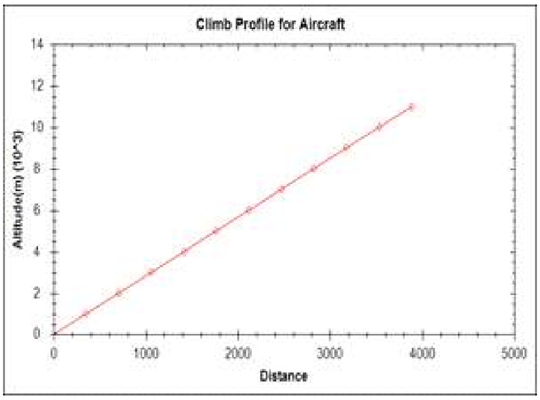

Fig. 7 Climb Time Based On Altitude

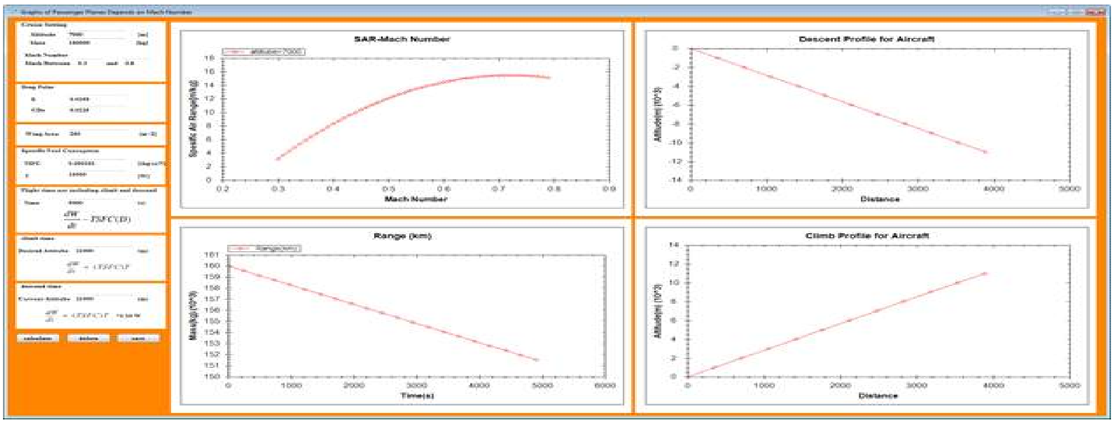

Fig. 7 Program Interfacfe

4. Conclusions

Design and drawing programs in the aerospace industry is very important. Because large amount of money are spent for to designing a high cost of the aircraft, modified and making analysis. Instead of using software programs, very close to the actual result was achieved using mathematical formulas

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