ISTANBUL TECHNICAL UNIVERSITY

FACULTY OF AERONAUTICS AND ASTRONAUTICS

UCK 421E – 19/20 SPRING TERM PROJECT

Afterburnıng Turbofan Engıne Wıth Seperate Exhaust System

INSTRUCTOR

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INDEX

FIGURES ... 3
TABLES ... 4
1. Introduction ... 5
1.1. Turbofan Engine's Working Principles ... 5
1.2. Common Types of Turbofan Engines ... 5
1.2.1. Low-Bypass Turbofan ... 5
1.2.2. Afterburning Turbofan ... 6
1.2.3. High-bypass Turbofan ... 7
1.2.4. Seperated Stream Turbofans with Afterburners ... 8
2. Flight Condition Parameters ... 9
2.1. Parameters ... 9
2.2. Design Constraints ... 10
2.3. Gas Properties ... 10
2.4. Fuel Properties ... 10
2.5. Component Performances ... 11
2.6. Design Choice Parameters ... 11
3. Cycle analysis ... 12
4. Software ... 15
5. Validation ... 18
6. Parameter Effects and Plots ... 19
6.1. Outputs with Respect to Varying Bypass Ratio (α) and Compressor Pressure Ratio (πc) ... 19
6.1.1. Fuel/Air Ratio ... 20
6.1.2. Specific Thrust ... 21
6.1.3. Specific Fuel Consumption ... 22
6.2. Efficiency ... 23
6.2.1. Propulsive Efficiency ... 23
6.2.2. Thermal Efficiensy ... 24
6.2.3. Overall Efficiensy ... 26
6.3. Outputs with Respect to Varying Bypass Ratio (α) and Fan Pressure Ratio (πf) ... 27
6.3.1. Specific Thrust ... 27
6.3.2. Specific Fuel Consumption ... 28
6.4. Outputs with Respect to Varying Bypass Ratio (α) and Mach Number ($M0$) ... 28

6.4. Outputs with Respect to Tt4, Tt7, Tt17 and Mach Number ($M0$) 30
7. Conclusion 34
References 35
APPENDIX 35

FIGURES

Figure 1 – Low Bypass Turbofan 6
Figure 2 – Afterburning Turbofan 7
Figure 3 - High-Bypass Turbofan 7
Figure 4 - Seperated Stream Turbofans with Afterburners 8
Figure 5 - Spesific thrust for varying bypass and Mach number 12
Figure 6- User Interface 15
Figure 7 – Input and Output Panels 16
Figure 8 - Case Selection 17
Figure 9 - Computing Program 17
Figure 10 Single condition program interface and results 19
Figure 11 - Outputs with Respect to Bypass Ratio and Compressor Pressure Ratio 19
Figure 12 - Fuel/Air Ratio 20
Figure 13 - Specific Thrust 21
Figure 14 - Specific Fuel Consumption 22
Figure 15 - Propulsive Efficiency with Varying Different Fan Pressure Ratios 23
Figure 16 - Propulsive Efficiency with Varying Different Compressor Pressure Ratios 23
Figure 17 - Propulsive Efficiency with Varying Different Bypass Ratios 24
Figure 18 - Thermal Efficiency with Varying Different Fan Pressure Ratios 24
Figure 19 - Thermal Efficiency with Varying Different Compressor Pressure Ratios 25
Figure 20 - Thermal Efficiency with Varying Different Bypass Ratios 25
Figure 21 – Overall Efficiency For Different Fan Pressure Ratios 26
Figure 22 - Overall Efficiency For Different Compressor Pressure Ratios 26
Figure 23 - Overall Efficiency For Different Bypass Ratios 26
Figure 24 - Design Choices 27
Figure 25 - Specific Thrust 27
Figure 26 - Specific Fuel Consumption 28
Figure 27 - Design Choices 29
Figure 28 - Specific Thrust 29
Figure 29 - Specific Fuel Consumption 30
Figure 30 - Design Choices 30
Figure 31 - Brayton Cycle 31
Figure 32 - Specific Thrust 31
Figure 33 - Specific Fuel Consumption 32
Figure 34 - Design Choices 32
Figure 35 - Specific Thrust 32
Figure 36 - Specific Fuel Consumption 33
Figure 37 - Design Choices 33
Figure 38 - Specific Thrust 34
Figure 39 - Specific Fuel Consumption 34

TABLES

Table 1 - Flight Condition Parameter Values of Similar Real Turbofan Engines 9
Table 2 - Flight Condition Parameters 10
Table 3 - Design Constraints.. 10
Table 4 - Gas Properties.. 10
Table 5 - Fuel Properties 11
Table 6 – Components Performances.. 11
Table 7 - Design Choice Parameters 12
Table 8 Comparison of reference book and program results 19

1. Introduction

Propulsion systems have needed to move an aircraft thruogh the air. Firstly, propeller engines are invented. During WW2 there was a need for more efficient propulsion engines. Because the propeller engines’ fuel efficincies and their thrusts were not enought for aviation. From the 1950s turbofan engines have modified and evolved. Today most modern aircrafts use turbofan engines because of their good fuel comsumption and high thrust.

A turbofan engine is the most modern variation of the basic gas turbine engine. Likely the other gas turbines, turbofan engine has a core engine. In turbofan engines the core engine is surrounded by a fan in the front and an additional turbine at the rear. In the fan and fan turbines there are various blades.

1.1. Turbofan Engine’s Working Principles

A turbofan can be thought of as a turbojet being used to drive a ducted fan, with both of those contributing to the thrust. Whereas all the air taken in by a turbojet passes through the turbine (through the combustion chamber), in a turbofan some of that air bypasses the turbine. Because the turbine has to additionally drive the fan, the turbine is larger and has larger pressure and temperature drops, and so the nozzles are smaller. This means that the exhaust velocity of the core is reduced. The fan also has lower exhaust velocity, giving much more thrust per unit energy.

In turbofans there is a bypass ratio. Bypass ratio means the ratio between the mass flow rate of the bypass stream to the mass flow rate entering the core. According to bypass ratio there are two types of turbofan engines; those are low-bypass turbofans and high-bypass turbofans. In high bypass turbofans the air ratio in the combustion chamber is bigger than high bypass turbofans. O the other hand in the light of this inforamtions it can be easily said in the low bypass ratio turbofans, engines use more jet thrust relative to fan thrust. If it is desired to see the working principles it can be seen below the link easily.

1.2. Common Types of Turbofan Engines

1.2.1. Low-Bypass Turbofan

A high-specific-thrust/low-bypass-ratio turbofan normally has a multi-stage fan, developing a relatively high pressure ratio and, thus, yielding a high (mixed or cold) exhaust velocity. The core airflow needs to be large enough to give sufficient core power to drive the fan. A smaller core flow/higher bypass ratio cycle can be achieved by raising the high-pressure turbine rotor inlet temperature. In Figure 1 there is an example of this type of turbofan.

When calculating the drag of an aircraft with a jet engine, we need to take into account the drag in the region with the jet outlet as well as many different factors. In particular, we have to calculate the forces acting on the nozzle on the regions we define as Boat Tail and

Base. The CFD analysis in these regions to calculate the forces and flow-related values after jet outlet is called Afterbody CFD Analysis.

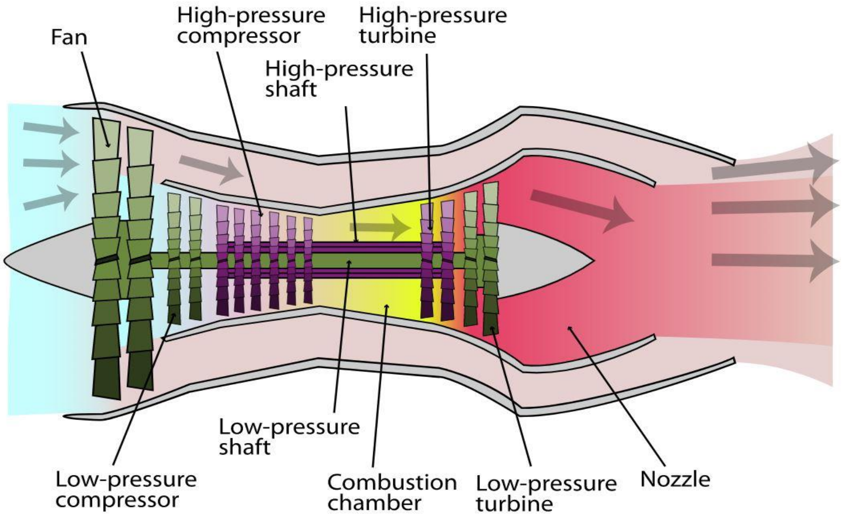

Figure 1 – Low Bypass Turbofan

1.2.2. Afterburning Turbofan

Since the 1970s, most jet fighter engines have been low/medium bypass turbofans with a mixed exhaust, afterburner and variable area final nozzle. An afterburner is a combustor located downstream of the turbine blades and directly upstream of the nozzle, which burns fuel from afterburner-specific fuel injectors. When lit, prodigious amounts of fuel are burnt in the afterburner, raising the temperature of exhaust gases by a significant degree, resulting in a higher exhaust velocity/engine specific thrust. The variable geometry nozzle must open to a larger throat area to accommodate the extra volume flow when the afterburner is lit. Afterburning is often designed to give a significant thrust boost for take off, transonic acceleration and combat maneuvers, but is very fuel intensive. Consequently, afterburning can be used only for short portions of a mission. In Figure 2 there is an example of this motor type.

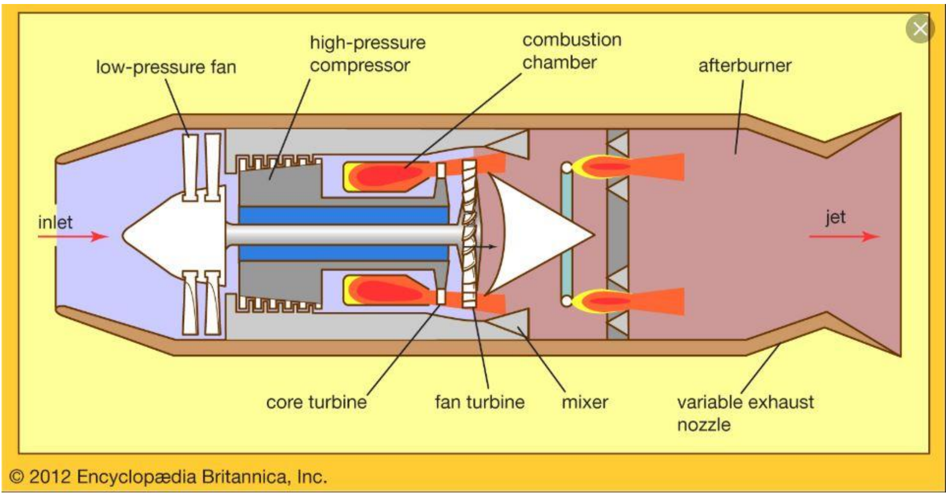

Figure 2 – Afterburning Turbofan

1.2.3. High-bypass Turbofan

To boost fuel economy and reduce noise, almost all of today's jet airliners and most military transport aircraft are powered by low-specific-thrust/high-bypass-ratio turbofans. These engines evolved from the high-specific-thrust/low-bypass-ratio turbofans used in such aircraft in the 1960s. Modern combat aircraft tend to use low-bypass ratio turbofans, and some military transport aircraft use turboprops.

Low specific thrust is achieved by replacing the multi-stage fan with a single-stage unit. Unlike some military engines, modern civil turbofans lack stationary inlet guide vanes in front of the fan rotor. The fan is scaled to achieve the desired net thrust. In Figure 3 there is an example of this motor type.

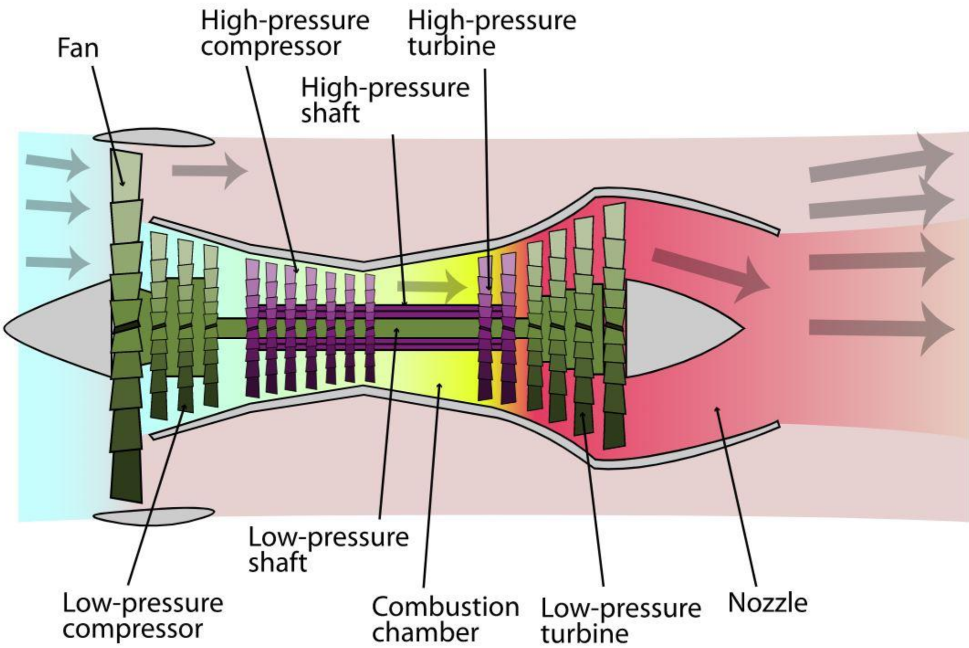

Figure 3 - High-Bypass Turbofan

1.2.4. Seperated Stream Turbofans with Afterburners

Our project group's topic is this type of turbofan engine. In this engine contains some parts of other type of turbofan engines. Because in this engine type it can be high or low bypass turbofan, it has seperated stream and 2 different type nozzle, and in it's two regions there are two types of fterburners whose names are duct burner and afterburner. This engine type has various adventages; however, with this adventages there are disadventages to. For example; during take off after burner and duct burners are activated, this shorten the runway of aircraft, but fuel consumption is increase. During cruise afer burner and duct burners are closed and there is no need to them. This cause mechanical weight on plane. However, battle combats and sudden maneuver are needed afterburner. Because of after burner and duct burner this type of turbofan's thermodynamic cycles are more complex than the other. In Figure 4 there is an example of this motor type.

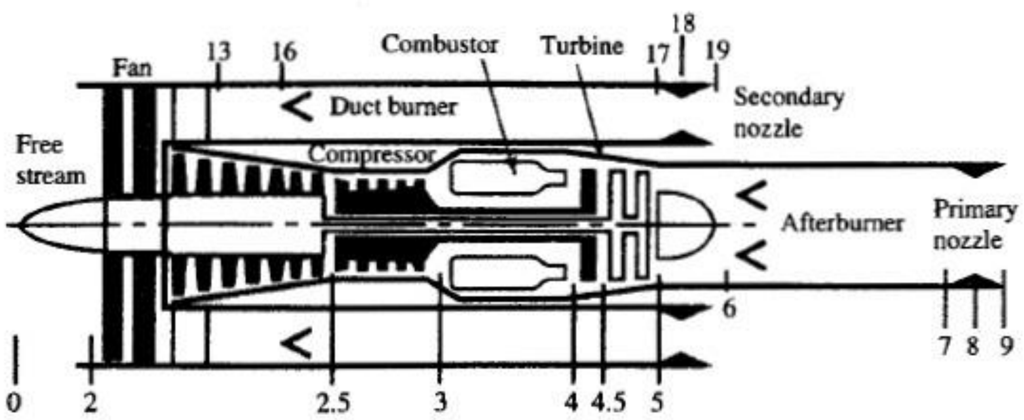

Figure 4 - Seperated Stream Turbofans with Afterburners

1.2.4.1. Spesific Pictures and Examples of Seperated Stream Turbofans with Afterburners

Our project group research this type of motor approximateliy two months. However, we could not find any examples or schematic of this type turbofan. Our class book has only this type turbofan but only it was only a description. Because of these stuations we could not find examples of motor and we could not do this part. Our research motor type websites are included after below and added to references.

http://jet-engine.net/index.html

https://en.wikipedia.org/wiki/Category:Turbofan_engines

https://en.wikipedia.org/wiki/Category:High-bypass_turbofan_engines

https://www.flightglobal.com/the-power-list-top-10-delivered-commercial-turbofans/116576.article

https://www.geaviation.com/commercial/engines

2. Flight Condition Parameters

Separate stream afterburning turbofan engine never produced in real life as we mentioned before. For the flight parameters of our engine, there was only one example in the textbook (Mattingly, 1996, p.416). We investigate the internet sites (airliners.net, theflyingengineer.com, en.wikipedia.org etc.), some research articles and some university archives to collect data for the similar turbofan engine types. Finally, we have analyzed the parameter values and decided the ranges of our flight condition parameters.

ENGINE	type	BPR	OPR	pif	tt4	tt7	tt17	effi comp	effi burn	eff turb	ef	pidmax	pib	nb/nab	pin	nm	pifn
leap-1a26	ss	11	40														
leap-1b25	ss	9	43,68														
pw1524g	ss	12	50														
pw1525g	ss	12	50														
pw1922g	ss	12	50														
pw1923g	ss	12	50														
leap-1b28	ss	9	43,68														
leap-1d28	ss	7	43,68														
pw1615g	ss	9	50														
v2527-a5	ss	4,8	32,8														
cfm56-5b4	ss	5,7	32,6														
cfm56-7b27	ss	5,5	32,7														
cfm leap-1b28	ss	9	43,68														
cfm56-7c27	ss	5,8	38,5														
cfm leap-1d28	ss	7	43,68														
pw jt8d-17a	mf	1,6	19														
volvo rm8	mfab	0,97	16,5														
cfm56-3c-1	ss	6	30,6														
pw1127g-jm	ss	12,5	50														
GEnX-1B-70	ss	9,1	43,5														
GE cf34-8c1	ss	5	16,5														
cfm56-7b18	ss	5,6	32,3														
pw4462	ss	4,8	32,3														
trent800	ss	6,5	42														
rb211-524g	ss	4,3	25,8														
ge90-76b	ss	-	40														
f100-229	mfab	0,35	32														
ej200	mfab	0,4	26	4,2													
f404/rm112	mfab	0,34	27														
baseline TF-CLAWS	mfab	0	6,2668		1111	1522		0,9026	0,995	0,8678							
TF-CLAWS	mfab	0,564	26,1	2,359	1723	-		-	-	-	0,9						
trent900	ss	8,02	41,1														
gp7000	ss	8,17	43,9														
LVL4 BOOK EoGT mat	ssab	0.5-3.0	10-30 (Pic)	2.0-5.0	2000	2200	2200	0,9	0,99	0,9	0,89	0,98	0.95-0.98	0,99	0,98	0,99	0,98
baseline CJ 3000	mf	1,91	36,8	2,276	1818												
CJ 3000	mf	2,75	45	2,44	1826												

Table 1 - Flight Condition Parameter Values of Similar Real Turbofan Engines

2.1. Parameters

M_0: Local mach number is a dimensionless ratio of the speed of the aircraft to the local speed of sound.

T_0: Local temperature of the aircraft which is changing with the height.

γ_c: Specific heat ratio at the upstream of main burner.

C_{pc}: Specific heat capacity at the upstream of main burner at constant pressure.

P_0/P_9: Ratio of the pressures at the freestream and at the exit of the afterburner.

P_0/P_{19}: Ratio of the pressures at the freestream and at the exit of the duct burner.

M_0	T_0	γc	C_{pc}	p0/p9	p0/p19
0 - 1.6	216.7	1.4	1.005	1	1

Table 2 - Flight Condition Parameters

2.2. Design Constraints

T_{t4}: Maximum turbine inlet temperature which depends the material.

T_{t7}: Maximum afterburner exit temperature which depends the material.

T_{t17}: Maximum duct burner exit temperature which depends the material.

T_{t4}(max)	T_{t7}(max)	T_{t17}(max)
1700-2000	2200	2200

Table 3 - Design Constraints

2.3. Gas Properties

γ_t: Specific heat ratio at the downstream of main burner.

C_{pt}: Specific heat capacity at the downstream of main burner at constant pressure.

γ_{AB}: Specific heat ratio at the downstream of afterburner.

C_{pAB}: Specific heat capacity at the downstream of afterburner at constant pressure.

γ_{DB}: Specific heat ratio at the downstream duct burner.

C_{pDB}: Specific heat capacity at the downstream of duct burner at constant pressure.

γt	C_{pt}	γ_{AB}	C_{pAB}	γ_{DB}	C_{pDB}
1.3	1.235	1.3	1.235	1.3	1.235

Table 4 - Gas Properties

2.4. Fuel Properties

h_{pr}: Lower heating value of fuel is the amount of heat released by combusting a specified quantity of fuel.

h_{pr}
4.28e+04

Table 5 - Fuel Properties

2.5. Component Performances

$\pi_{d\ max}$: Total pressure ratio of the inlet with the effects of wall friction

π_{AB}: Total pressure ratio of the afterburner

π_n: Total pressure ratio of the nozzle

π_b: Total pressure ratio of the main burner

π_{fn}: Total pressure ratio of the fan nozzle

π_{DB}: Total pressure ratio of the duct burner

η_b: Isentropic efficiency of the main burner

η_{AB}: Isentropic efficiency of the afterburner

η_{DB}: Isentropic efficiency of the duct burner

η_m: Mechanical efficiency of the coupling between compressor, turbine and fan

e_c: Polytropic efficiency of the compressor

e_f: Polytropic efficiency of the fan

e_t: Polytropic efficiency of the türbine

$\pi_{d\ max}$	π_{AB}	π_n	e_c	e_t	η_{AB}	η_m	π_b	π_{DB}	π_{fn}	e_f	η_b	η_{DB}
0.98	0.94	0.98	0.9	0.91	0.95	0.99	0.98	0.94	0.98	0.89	0.99	0.95

Table 6 – Components Performances

2.6. Design Choice Parameters

π_c: Compressor pressure ratio

π_f: Fan pressure ratio

α: Bypass ratio

π_c	π_f	α
5 - 30	2 - 5	0.5 - 5

Table 7 - Design Choice Parameters

3. Cycle analysis

We now consider a turbofan engine cycle with separate exhaust streams in which afterbuming may operate in the core stream and duct burning may operate in the fan stream. When both the afterburner and duct burner are in operation, this engine cycle will give substantially higher specific thrust than the basic turbofan cycle, while still providing the low fuel consumption of the basic turbofan engine cycle when both the afterburner and duct burner are turned off.

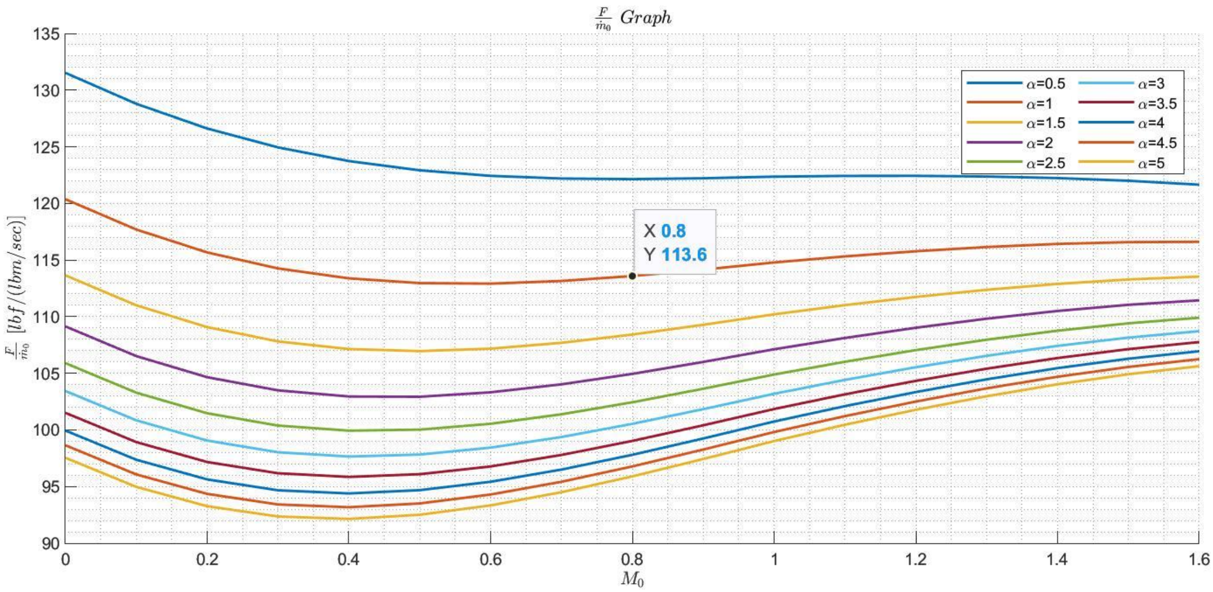

Figure 5 Spesific thrust for varying bypass and Mach number

Assumptions:

- Perfect gas upstream of main burner with constant properties
- Perfect gas downstream of main burner with constant properties
- Perfect gas downstream of afterburner with constant properties
- Perfect gas downstream of duct burner with constant properties
- All components adiabatic (no turbine cooling)
- The efficiencies of the compressor, fan, and turbine described through the use of (constant) polytropic efficiencies.

Inputs: $M_0, T_0(\mathrm{K}, {}^\circ\mathrm{R}), \gamma_c, c_{pc}\left(\frac{\mathrm{kJ}}{\mathrm{kg \cdot K}}, \frac{\mathrm{Btu}}{\mathrm{Ibm \cdot {}^\circ R}}\right), \gamma_n, c_{pt}\left(\frac{\mathrm{kJ}}{\mathrm{kg \cdot K}} \frac{\mathrm{Btu}}{\mathrm{Ibm \cdot {}^\circ R}}\right) \backslash$

$$h_{PR}\left(\frac{\mathrm{kJ}}{\mathrm{kg}}, \frac{\mathrm{Btu}}{\mathrm{Ibm}}\right), \gamma_{\mathrm{AB}}, c_{p\mathrm{AB}}\left(\frac{\mathrm{kJ}}{\mathrm{kg \cdot K}}, \frac{\mathrm{Btu}}{\mathrm{Ibm \cdot {}^\circ R}}\right) \gamma_{\mathrm{DB}}, c_{p\mathrm{DB}}\left(\frac{\mathrm{kJ}}{\mathrm{kg \cdot K}}, \frac{\mathrm{Btu}}{\mathrm{Ibm \cdot {}^\circ R}}\right)\Bigg) \backslash$$

$$\pi_{dmax}, \pi_b, \pi_{\mathrm{AB}}, \pi_{\mathrm{DB}}, \pi_n, \pi_{\mathrm{fn}}, e_c, e_f, e_t, \eta_b, \eta_{AB}, \eta_{DB}, \eta_m, P_0/P_9$$

$$P_0/P_{19}, T_{t4}(K,^\circ R) T_{t7}(\mathrm{K},^\circ \mathrm{R}), T_{t17}(\mathrm{K},^\circ \mathrm{R}), \pi_c, \pi_f$$

Outputs:

$$\frac{F}{\dot{m}0}\left(\frac{\mathrm{N}}{\mathrm{kg/sec}}, \frac{\mathrm{lbf}}{\mathrm{1bm/sec}}\right), f, f\mathrm{AB}, f_{\mathrm{DB}}, S\left(\frac{\mathrm{mg/sec}}{\mathrm{N}}, \frac{\mathrm{lbm/hr}}{\mathrm{Ibf}}\right), \eta_T, \eta_P, \eta_O, \eta_c, \eta_t, \text{etc.}$$

Equations:

$$R_c = \frac{\gamma_c - 1}{\gamma_c} c_{pc}$$

$$R_t = \frac{\gamma_t - 1}{\gamma_t} c_{pt}$$

$$R_{\mathrm{AB}} = \frac{\gamma_{\mathrm{AB}} - 1}{\gamma_{\mathrm{AB}}} c_{\mathrm{pAB}}$$

$$R_{DB} = \frac{\gamma_{DB} - 1}{\gamma_{DB}} c_{pDB}$$

$$a_0 = \sqrt{\gamma_c R_c g_c T_0}$$

$$V_0 = a_0 M_0$$

$$\tau_r = 1 + \frac{\gamma_c - 1}{2} M_0^2$$

$$\pi_r = \tau_r^{\gamma_r/(\gamma_r - 1)}$$

$$\eta_r = 1 \quad \text{for } M_0 \leq 1$$

$$\eta_r = 1 - 0.075(M_0 - 1)^{1.35} \quad \text{for } M_0 > 1$$

$$\pi_d = \pi_{dmax} \eta_r$$

$$\tau_\lambda = \frac{c_{\rho t} T_{t4}}{c_{pc} T_0}$$

$$\tau_{\lambda AB} = \frac{c_{pAB} T_{i7}}{c_{pc} T_0}$$

$$\tau_{\lambda DB} = \frac{c_{\rho DB} T_{t17}}{c_{pc} T_0}$$

$$\tau_c = \pi_c^{(\gamma_c - 1)/(\gamma_c e_c)}$$

$$\eta_c = \frac{\pi_c^{(\gamma_c - 1)/\gamma_c} - 1}{\tau_c - 1}$$

$$\tau_f = \pi_f^{(\gamma_c - 1)/(\gamma_c e_f)}$$

$$\eta_f = \frac{\pi_f^{(\gamma_c - 1)/\gamma_c} - 1}{\tau_f - 1}$$

Application of the first law of thermodynamics to the burner and solving for the fuel/air ratio gives

$$f = \frac{\tau_\lambda - \tau_r \tau_c}{\eta_b h_{PR}/(c_{pc} T_0) - \tau_\lambda}$$

Solving the power balance between the turbine, compressor, and fan, with a mechanical efficiency of the coupling between the turbine and compressor and fan for the turbine temperature ratio gives

$$\tau_t = 1 - \frac{1}{\eta_m (1 + f)} \frac{\tau_r}{\tau_\lambda} \left[\tau_c - 1 + \alpha(\tau_f - 1)\right]$$

$$\pi_t = \tau_t^{\gamma_0} \{((\gamma_r - 1) e_\epsilon]$$

$$\eta_t = \frac{1 - \tau_t}{1 - \tau_t^{1/\epsilon_t}}$$

$$\frac{P_{r9}}{P_9} = \frac{P_0}{P_9} \pi_r \pi_d \pi_c \pi_b \pi_t \pi_{AB} \pi_n$$

$$M_9 = \sqrt{\frac{2}{\lambda - 1}\left[\left(\frac{P_{r9}}{P_9}\right)^{(\gamma_{AB} - 1)/\gamma_{AB}} - 1\right]}$$

$$\frac{T_0}{T_0} = \frac{T_n/T_0}{(P_0/P_0)^{(\gamma_{AB} - 1)/\gamma_{AB}}}$$

$$\frac{V_0}{a_0} = M_9 \sqrt{\frac{\gamma_{\mathrm{AB}} R_{\mathrm{AB}} T_9}{\gamma_c R_c T_0}}$$

$$\frac{P_{t19}}{P_{19}} = \frac{P_0}{P_{19}} \pi_r \pi_d \pi_f \pi_{\mathrm{DB}} \pi_{f_{fn}}$$

In a manner completely similar to the afterburning turbojet, we have

$$M_{19} = \sqrt{\frac{2}{\gamma_{\mathrm{DB}} - 1}\left[\left(\frac{P_{\mathrm{t19}}}{P_{19}}\right)^{(\gamma_{\mathrm{DB}} - 1)/\gamma_{\mathrm{DB}}} - 1\right]}$$

$$\frac{T_{19}}{T_0} = \frac{T_{t17}/T_0}{(P_{t19}/P_{19})^{(\gamma_{DB} - 1)/\gamma_{DB}}}$$

$$\frac{V_{19}}{a_0} = M_{19} \sqrt{\frac{\gamma_{\mathrm{DB}} R_{\mathrm{DB}} T_{19}}{\gamma_c R_c T_0}}$$

$$f_{\mathrm{AB}} = (1+f)\frac{\tau_{\lambda \mathrm{AB}} - \tau_\lambda \tau_t}{\eta_{\mathrm{AB}} h_{PR}/(c_{pc}T_0) - \tau_{\lambda AB}}$$

The energy balance across the duct burner gives

$$f_{\mathrm{DB}} = \frac{\tau_{\lambda \mathrm{DB}} - \tau_r \tau_f}{\eta_{\mathrm{DB}} h_{PR}/(c_{pc}T_0) - \tau_{\lambda \mathrm{DB}}}$$

The expression for the specific thrust of this engine cycle is

$$\frac{F}{\dot{m}_0} = \frac{1}{1+\alpha}\frac{a0}{g_c}\left[(1+f+f_{AB})\frac{V_9}{a_0} - M_0 + (1+f+f_{AB})\times\frac{R_{AB}}{R_c}\frac{T_9/T_0}{V_0/a_0}\frac{1-P_0/P_0}{\gamma_c}\right]$$
$$+\frac{\alpha}{1+\alpha}\frac{a_0}{g_c}\left[(1+f_{DB})\frac{V_{19}}{a_0} - M_0 + (1+f_{\mathrm{DB}})\times\frac{R_{\mathrm{DB}}T_{19}/T_0}{R_c}\frac{1-P_0/P_{19}}{V_{19}/a_0}\right]$$

$$S = \frac{f + f_{AB} + \alpha f_{DB}}{(1+\alpha)(F/m_0)}$$

4. Software

As a software, MATLAB based UI (User Interface) that can be used in parametric cycle analysis of the Separated Stream Afterburner Turbofan is designed. When software is opened, first image of the software is given in Figure 6.

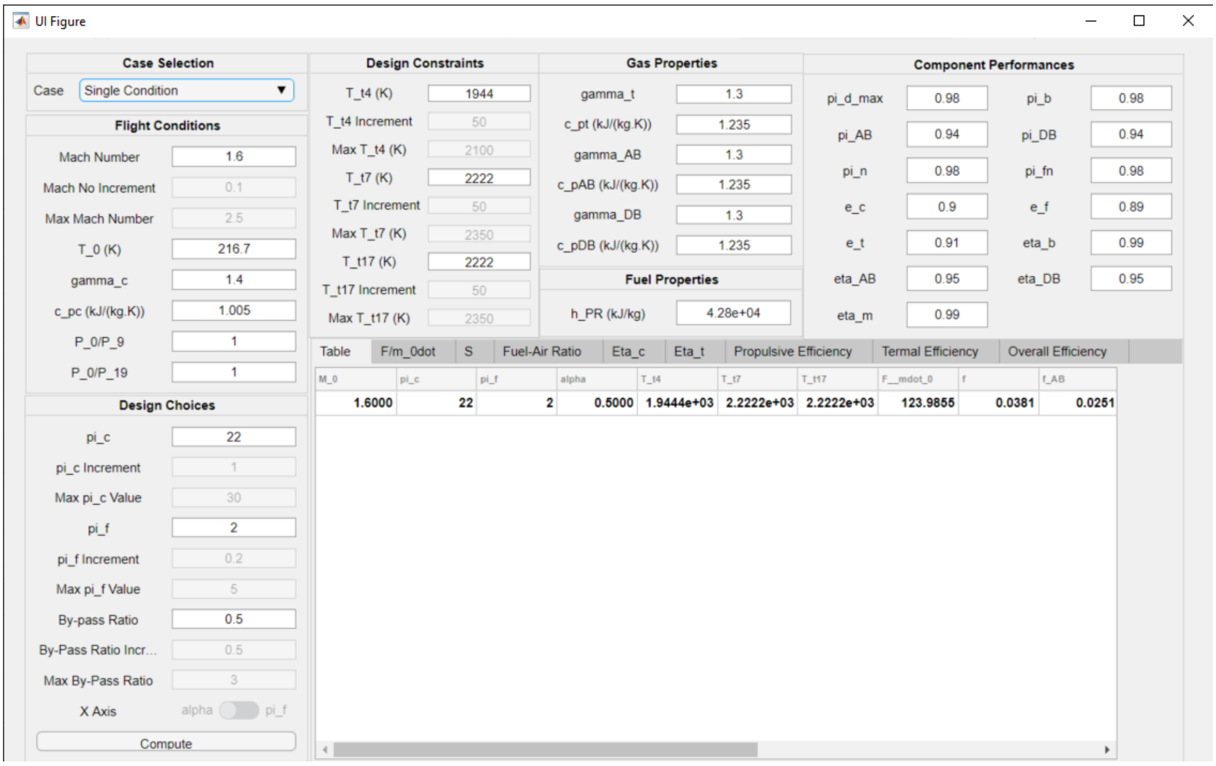

Figure 6- User Interface

Input parameters and options are grouped into separate panels according to their specification. Output panel is at the bottom right. Output panel has multiple tabs that contains a table and plots of the various output parameters. For every computation, input and output parameters tabulated together at the Table Tab. At the Figure 7 input panels and output panel are highlighted in red and blue respectively.

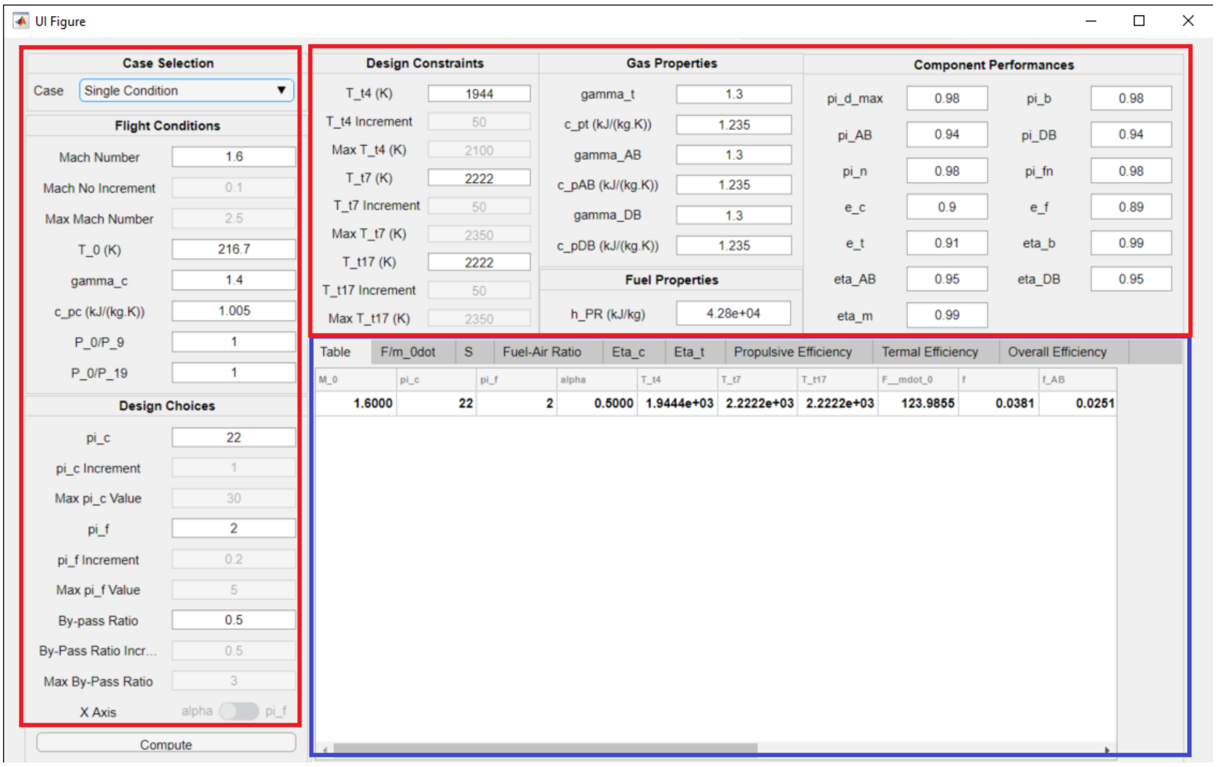

Figure 7 – Input and Output Panels

At the upper left Case Selection Panel can be seen (highlighted in purple) at Figure 8. There is a dropdown menu for the case selection and available solver options are seen in the menu. When case is selected, required edit fields are enabled and unnecessary fields are disabled.

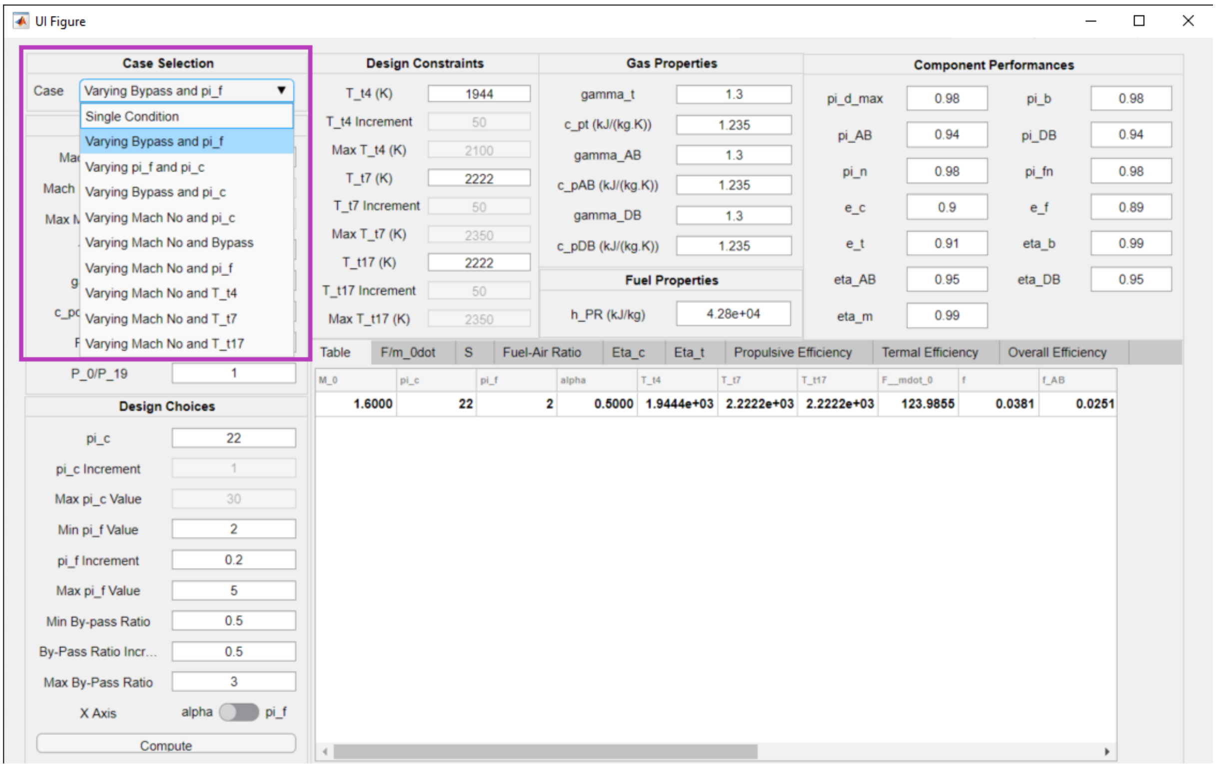

Figure 8 - Case Selection

When all of the parameters are entered, by clicking the Compute button program computes the outputs, tabulates and plots the result for the selected X-Axis (Figure 9).

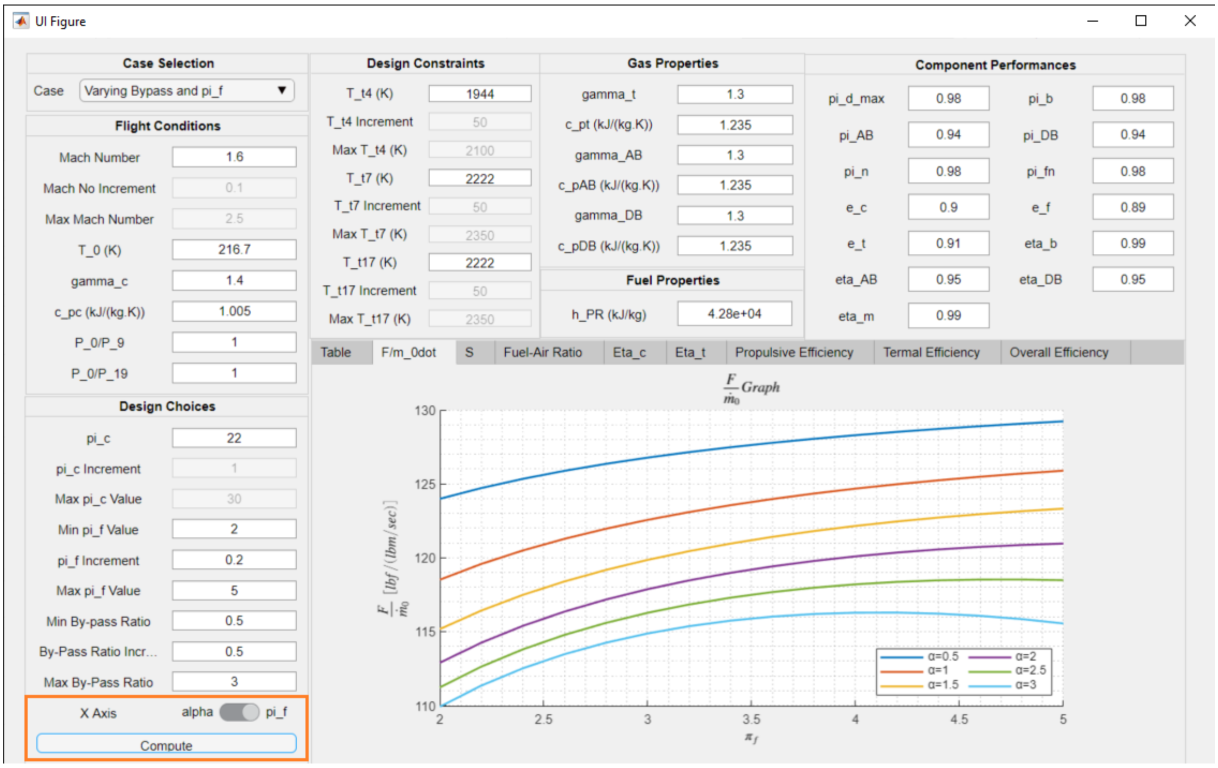

Figure 9 - Computing Program

Source code of the software is given in the Appendix. Software can be run MATLAB 2019b or later versions.

5. Validation

In this topic, validation study was carried out to confirm the accuracy of the data of the Parametric Cycle analysis program. Since an error was detected in the solution of the sample question of Afterburning Turbofan with Separate Exhaust (SSATF) in the reference book, the validation study was done with Example 7-6, which is the example of Separated Exhaust Stream Turbofan Engine (SSTF). Example 7-6 Unlike our analysis program, since it does not contain an afterburner, it is necessary to make adjustments in SSATF cycle analysis formulas and parametric analysis inputs.

First, the heat energy added to the flow in the duct burner and afterburner regions in Figure 4 is reduced to zero value in order to neutralize the afterburner event in the analysis. As seen in Equation (1), the fuel spent during the afterburner functions to increase the temperature of the air from T_{t6} to T_{t7} using the energy balance across the duct burner. For this reason, when the T_{t6} temperature is written instead of the T_{t7} value in the analysis calculations, the fuel will not be consumed in the afterburner part and the flow will progress to the nozzle at the same temperature. Tt6 is calculated through equation (2). Since the T_{t4} value in the equation is known as the input depressor in the analysis, the T_{t6} value was obtained by taking into account the temperature drop in the turbine and the burning in the afterburner was prevented by writing the T_{t7} temperature instead. In this way, the flow temperature remained the same and the gas characteristics at the afterburner station were taken with the same values as the turbine gas characteristics shown in Figure 10.

$$(\dot{m}_0 + \dot{m}_f)c_{pt}T_{t6} + \eta_{AB}\dot{m}_{fAB}h_{PR} = \left(\dot{m}_0 + \dot{m}_f + \dot{m}_{fAB}\right)c_{pAB}T_{t17} \tag{1}$$

$$T_{t6} = T_{t4} * \frac{T_{t5}}{T_{t4}} * \frac{T_{t6}}{T_{t5}} = T_{t4} * \tau_t * 1 = 3000 * 0.54866 * 1 = 1645.82\ °R = 914.3465\ K \tag{2}$$

The same method will be examined in the duct burner section. When the equation (7-64) is examined, it is seen that the fuel spent during the duct burner increases the air from T_{t16} temperature to T_{t17} temperature. In the cycle analysis formulas, if T_{t16} value is written to T_{t17} temperature, there will be no burning in the duct burner part of the engine. T_{t16} is calculated by equation (4). As a result, since there will be no combustion in the duct burner part of the engine, the flow in this region will have the same gas characteristics as the flow in the fan part. Gas properties are shown in Figure 10.

$$\dot{m}_F c_{pc} T_{t16} + \eta_{DB}\dot{m}_{fDB}h_{PR} = \left(\dot{m}_F + \dot{m}_{fDB}\right)c_{pDB}T_{t17} \tag{3}$$

$$T_{t16} = T_0 * \frac{T_{t2}}{T_0} * \frac{T_{t13}}{T_{t2}} = T_0 * \tau_r * \tau_f = 390 * 1.128 * 1.1857 = 1645.82\ °R = 289.8\ K \tag{4}$$

Afterburner and duct burner efficiencies were taken as 1 to avoid loss of efficiency in the combustion parts. Finally, other input parameters shown in Figure 10 are entered into the program and the results are obtained by operating with the single condition case option. The program results are compared with reference book solutions in Table 8.

Group 4	$\frac{F}{\dot{m}_0}$ (lbf/(lbm/sec))	f	S (lbm/hr)/lbf)	η_c	η_f	η_t	η_P	η_T	η_O
Book	18.02	0.02868	0.6366	0.842	0.882	0.92	0.66124*	0.409	0.271*
Program	18.0248	0.0287	0.6364	0.8417	0.8815	0.92	0.6627	0.409	0.271

* *There is an error in the calculation in the book, the value of V19 / a0 is wrong*

Table 8 Comparison of reference book and program results

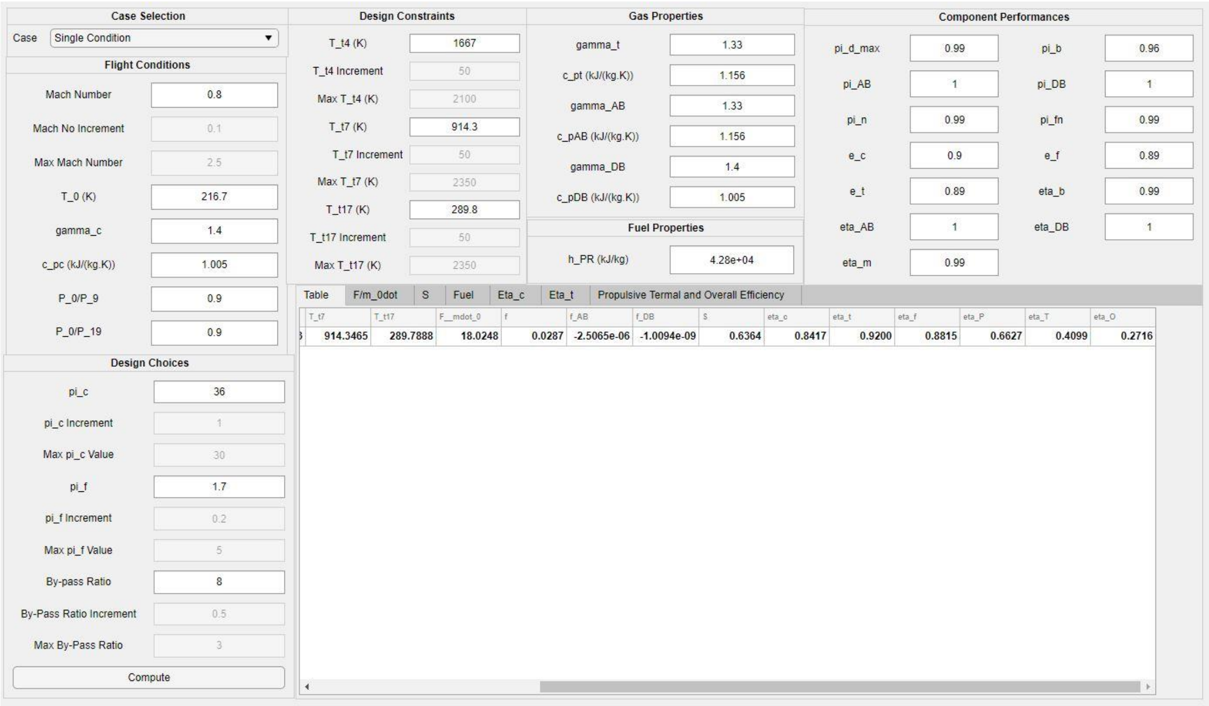

Figure 10 Single condition program interface and results

When the results of Figure 10 are examined, it is seen that the parameters f_{AB} and f_{DB} are equal to zero. As a result, the afterburner was successfully disabled. When Table 8 is examined, it is observed that the results are consistent and the validation study is completed.

6. Parameter Effects and Plots

6.1. Outputs with Respect to Varying Bypass Ratio (α) and Compressor Pressure Ratio (π_c)

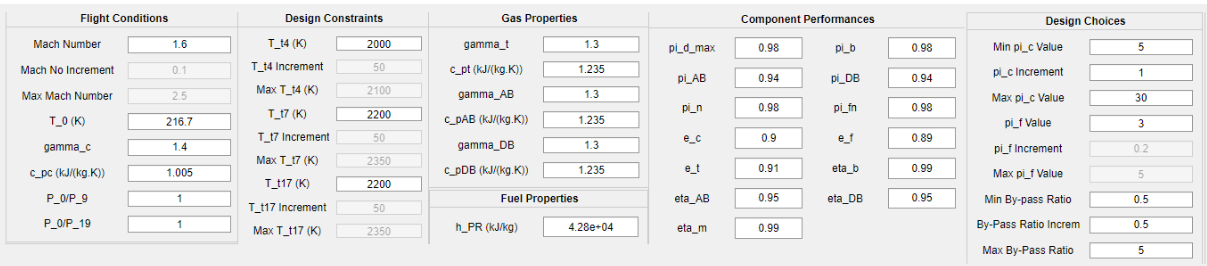

Figure 11 - Outputs with Respect to Bypass Ratio and Compressor Pressure Ratio

6.1.1. Fuel/Air Ratio

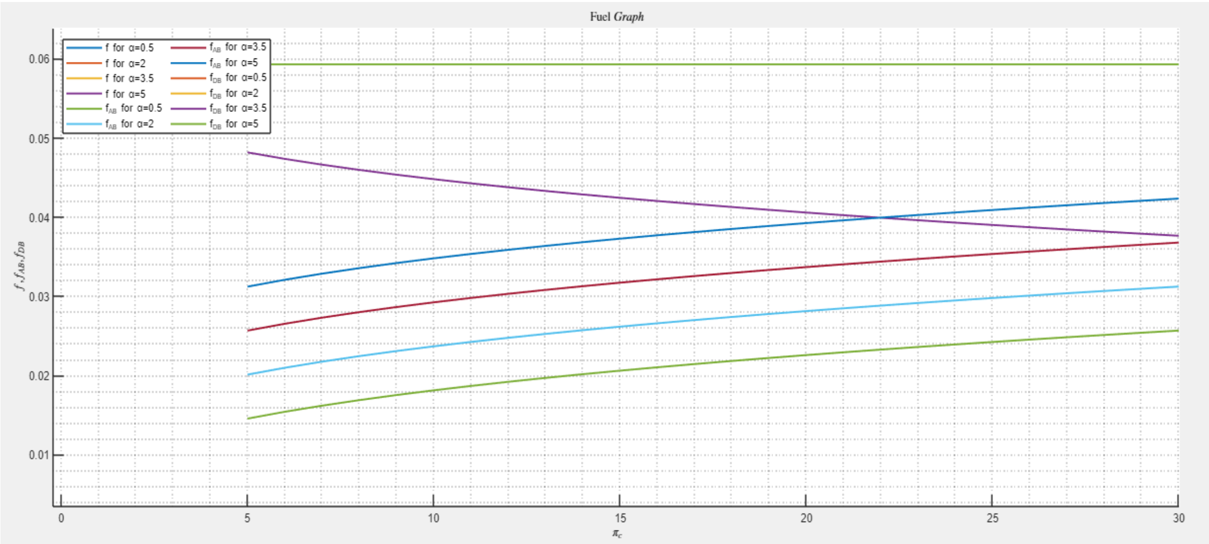

Figure 12 - Fuel/Air Ratio

<u>Duct Burner Fuel/Air Ratio:</u>

The green curve on the top shows the fuel/air ratio in Duct Burner. It seems to be overlapped because it is equal for each bypass ratio. Against the change of bypass ratio and compressor compression ratio, the fuel-air ratio of the Duct burner did not give a response and remained stable. As the limiting factor of the duct burner fuel-air ratio is the duct burner outlet temperature, it is normal that it does not respond to these two variables. This value is fixed at around 0.06. The differentiation of this value is related to the energy of the air coming to the Duct burner. That is, the parameters that can change this value can be specified as the T0 M0 values in the flight condition and the fan compression ratio. Since the total temperature at the duct burner outlet is limited from the top; Since the incoming air has a high temperature, the Mach number is high, and the fan compression ratio is high, the energy of the air entering the duct burner will also be high. Less fuel will be sufficient to reach the limited value.

<u>Combustion Chamber Fuel/Air Ratio:</u>

The purple curve, just below the previous curve (2nd curve on the graph), shows the fuel/air ratio in the core combustion chamber. This value also seems to be overlapped because it does not change with the bypass ratio. The bypass ratio is ineffective for the internal energy of the air entering the core combustion chamber. The compressor pressure ratio shows the work done in the compressor to air. In other words, as the compressor pressure ratio increases, the energy of air at the core combustion chamber entrance increases. For this reason, depending on the limited turbine inlet temperature, the required fuel will decrease as the compressor pressure ratio increases.

<u>Core Afterburner Fuel/Air Ratio:</u>

The remaining 4 curves show the fuel/air ratio of the afterburner in the core. The bypass ratios are as follows, from top to bottom; 1_Dark Blue: 5, 2_Red: 3.5, 3_Light Blue: 2, 4_Green: 0.5. As can be seen here unlike the others; The fuel that can be burnt increased as the bypass ratio increased and the compressor pressure ratio increased. If the energy of the air coming into the afterburner inlet is low, to reach the limited afterburner outlet temperature; more fuel can be burned. The increasing compressor pressure ratio causes a decrease in the temperature of the air coming to the afterburner inlet because the energy required to reach a high compression ratio is taken from the turbine. Taking more energy from the turbine while the turbine inlet temperature is constant at its upper limit means to lower the turbine outlet temperature more. In other words, getting more energy from the turbine to increase the compressor pressure ratio will decrease the temperature of the air coming to the core afterburner. In this way, more fuel can be burned. It also appears that for a fixed compressor pressure ratio, the fuel/air ratio increases as the bypass ratio increases. Because the total temperature in the turbine decreases as the bypass ratio increases and the temperature of the air entering the afterburner decreases; In this way, more fuel can be burned to reach the maximum afterburner outlet temperature.

6.1.2. Specific Thrust

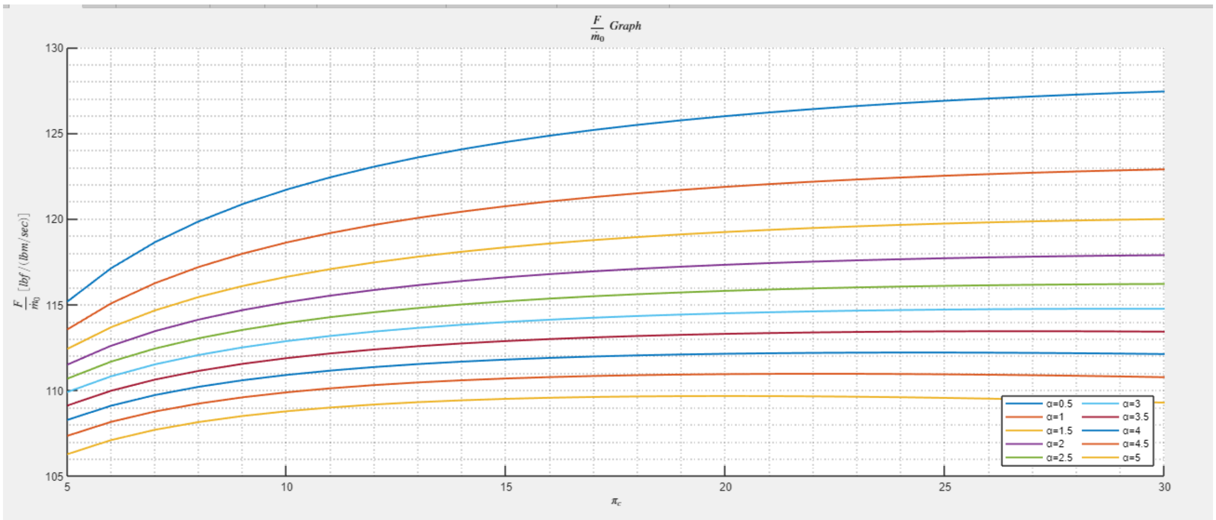

Figure 13 - Specific Thrust

This graph shows compressor pressure ratio and specific thrust values from 0.5 bypass ratio in ascending order to the top, from 0.5 increments to 5 bypass ratio. In the first reading of the graph, the increased compressor pressure ratio increased the specific thrust for a fixed bypass ratio. The rate of this increase decreased as the pressure ratio increased, and even became negative for low bypass ratios. That is, the compressor compression ratio has an optimum for specific thrust. Although we know that high compression ratios will benefit in ideal cycles, the energy drawn from the turbine, whose material inlet temperature is constant, may not meet the very high compressor pressure ratios. Also in a real situation; both to give higher energy to the air and to take higher energy from the air can decrease the efficiency, and the structural weight may increase to meet these loads as the loads on the parts will increase. For these reasons, while determining the optimum; As the compressor pressure ratio increases, the increase rate of the specific thrust decreases, and the values at reasonable levels where it starts to decrease should be selected.

In the second reading of the graph, at a fixed compressor pressure ratio, the specific thrust value decreases as the bypass ratio increases. This does not mean that the total thrust is reduced. Because this value is proportional to the mass flow. The main purpose of keeping the bypass ratio high in Turbofan engines is to accelerate the air with more mass to lower speeds and produce thrust, and the specific thrust of Turbofan engines is generally low. This value gives us information about its size due to the size of the air intake of the engine. That is, as the bypass ratio increases, a larger motor is required for a constant thrust.

6.1.3. Specific Fuel Consumption

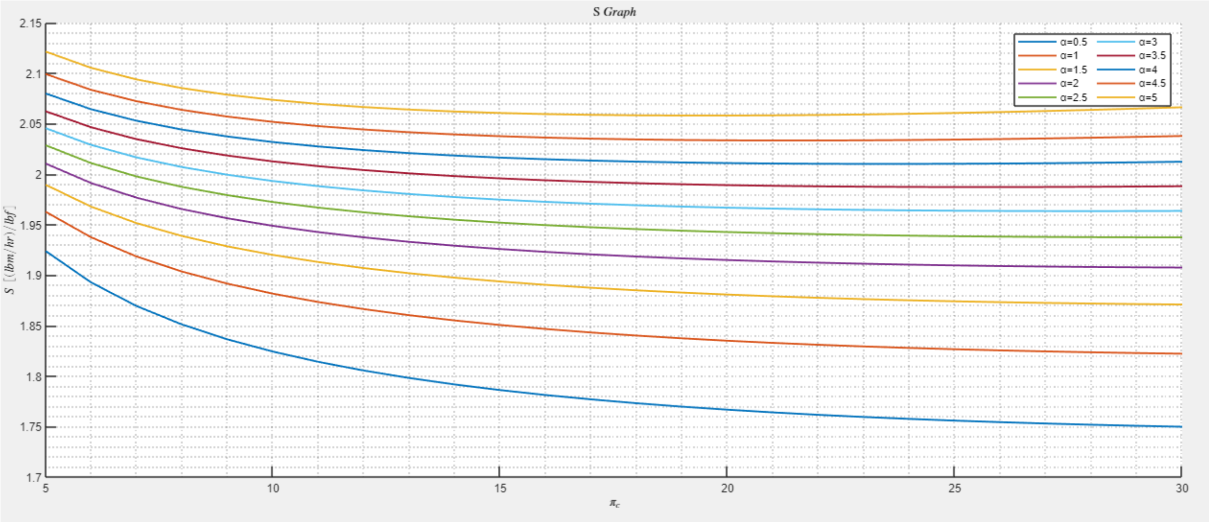

Figure 14 - Specific Fuel Consumption

In this graph, the curves started from 0.5 in order from bottom to top according to the bypass ratio and reached 5 in 0.5 increments. In other words, the bottom blue curve shows a 0.5 bypass ratio, while the top yellow curve shows a 5 bypass ratio. We can see that the specific fuel consumption decreases as the compressor pressure ratio increases. From the graph, we can see the philosophy of the cycles as the rate of compression increases, the energy received increases compared to the energy given. However, this situation turns into a disadvantage when high compressor pressure ratios are reached. In this graph, an optimum with reasonable values should be sought.

In the secondary reading of the graph, while the bypass ratio increases for a fixed compressor pressure ratio, the specific fuel consumption increases. This is a contrast to the separate flow turbofan. Because the main purpose of increasing the bypass ratio is the reduction in fuel consumption. The contradiction in this engine is due to the core afterburner. As the first graphic interprets, the core afterburner can burn more fuel as the bypass ratio increases. Because the total temperature in the turbine decreases as the bypass ratio increases and the temperature of the air entering the afterburner decreases; In this way, more fuel can be burned to reach the maximum afterburner outlet temperature. This situation increases the specific fuel consumption, contrary to what is expected, instead of decreasing, as the bypass ratio increases.

6.2. Efficiency

6.2.1. Propulsive Efficiency

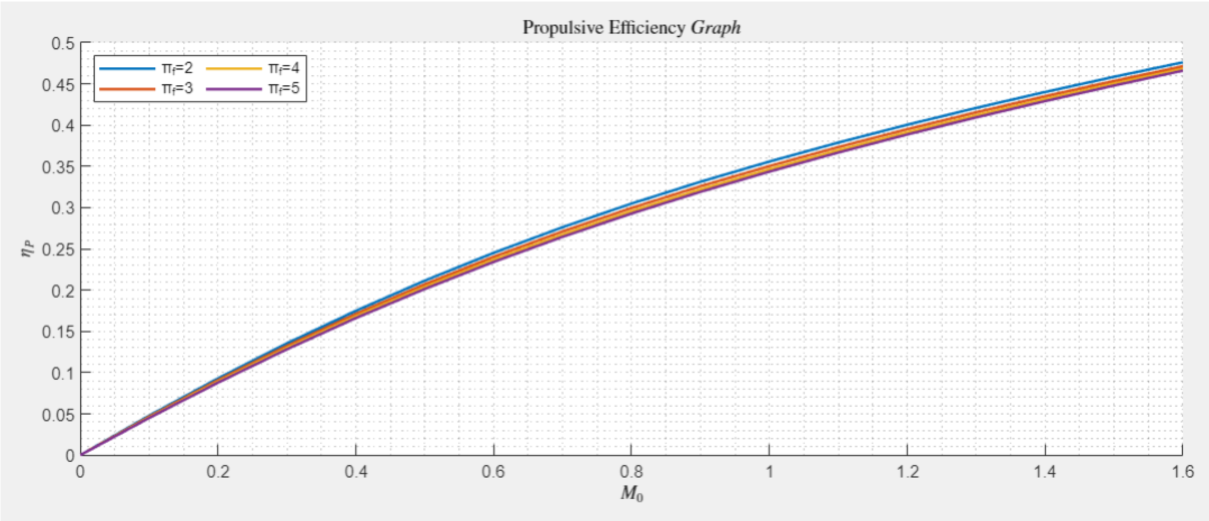

Figure 15 - Propulsive Efficiency with Varying Different Fan Pressure Ratios

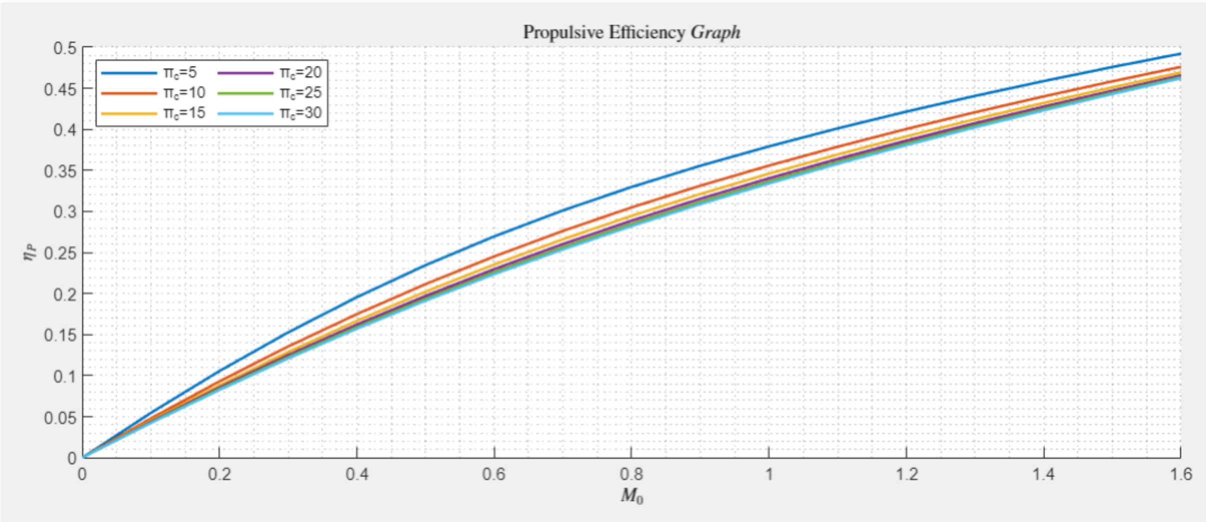

Figure 16 - Propulsive Efficiency with Varying Different Compressor Pressure Ratios

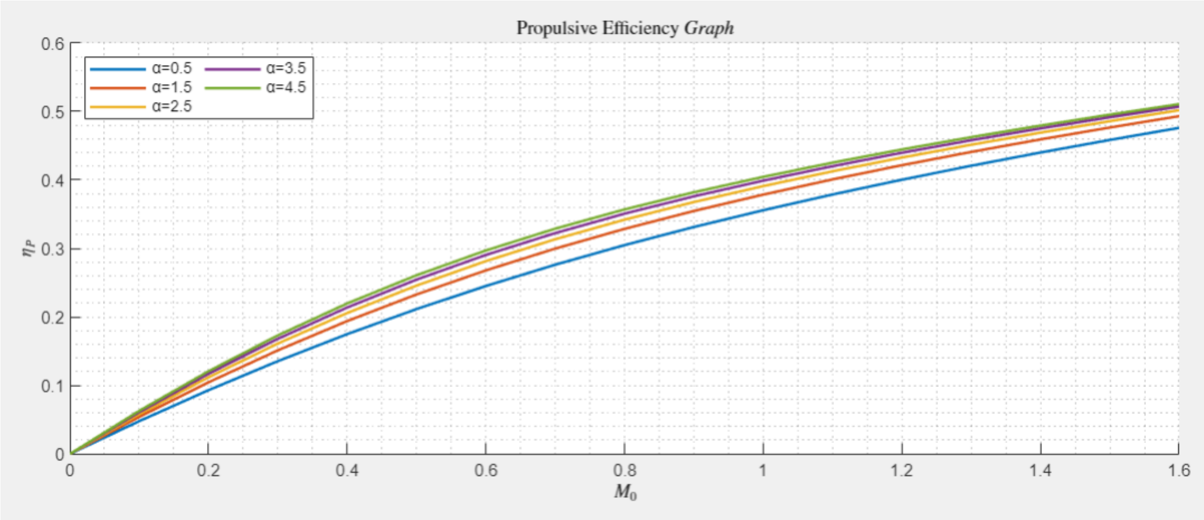

Figure 17 - Propulsive Efficiency with Varying Different Bypass Ratios

The graphs illustrate the propulsive efficiency with varying Mach number, fan pressure ratio, compressor pressure ratio and by-pass ratio. With increasing Mach number the propulsive efficiency is also increasing as expected in all engines. But any increase in fan pressure ratio and compressor pressure ratio has a slight negative effect on the propulsive efficiency of the engine because of the extra losses in compressor and fan. Contrarily, the augmentation of the by-pass number increases the propulsive efficiency.

6.2.2. Thermal Efficiensy

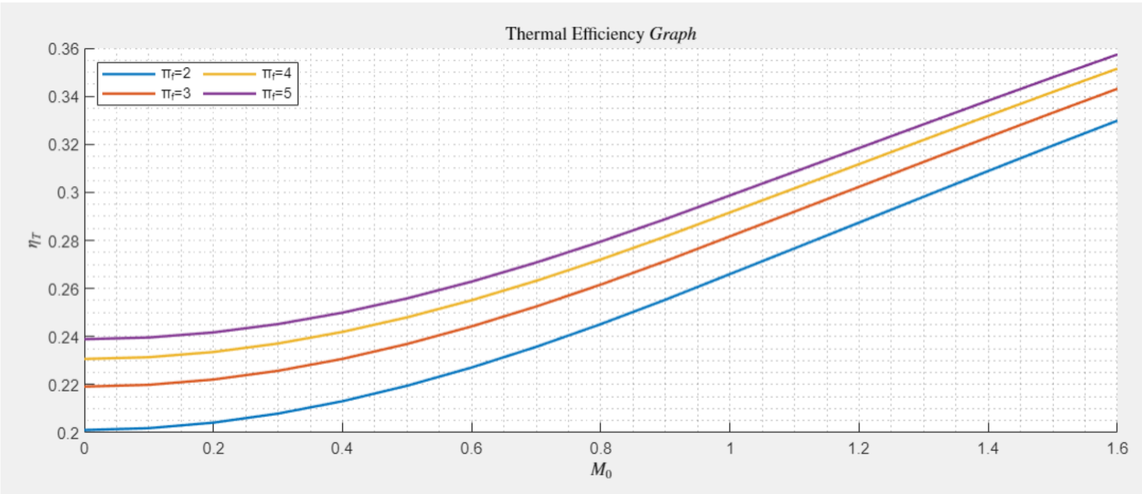

Figure 18 - Thermal Efficiency with Varying Different Fan Pressure Ratios

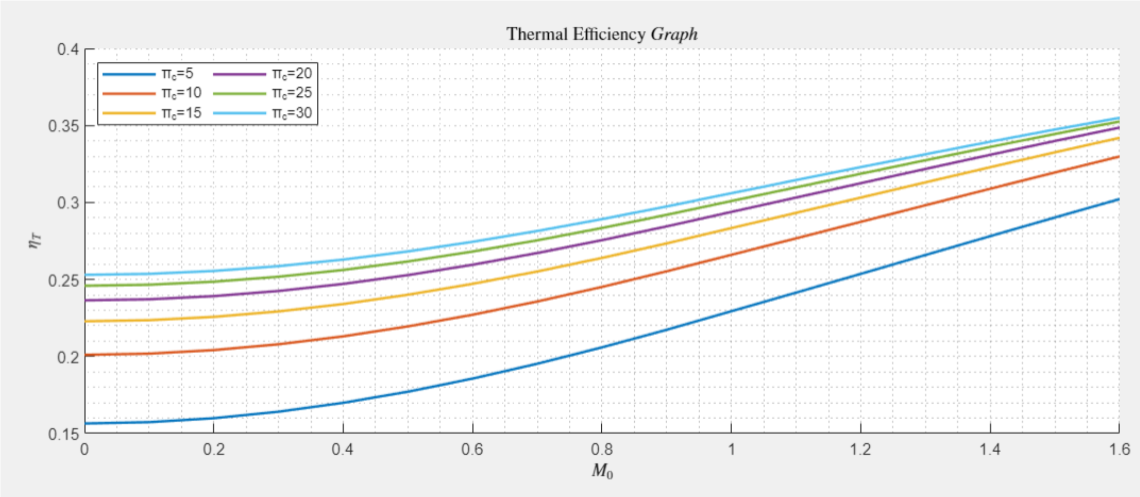

Figure 19 - Thermal Efficiency with Varying Different Compressor Pressure Ratios

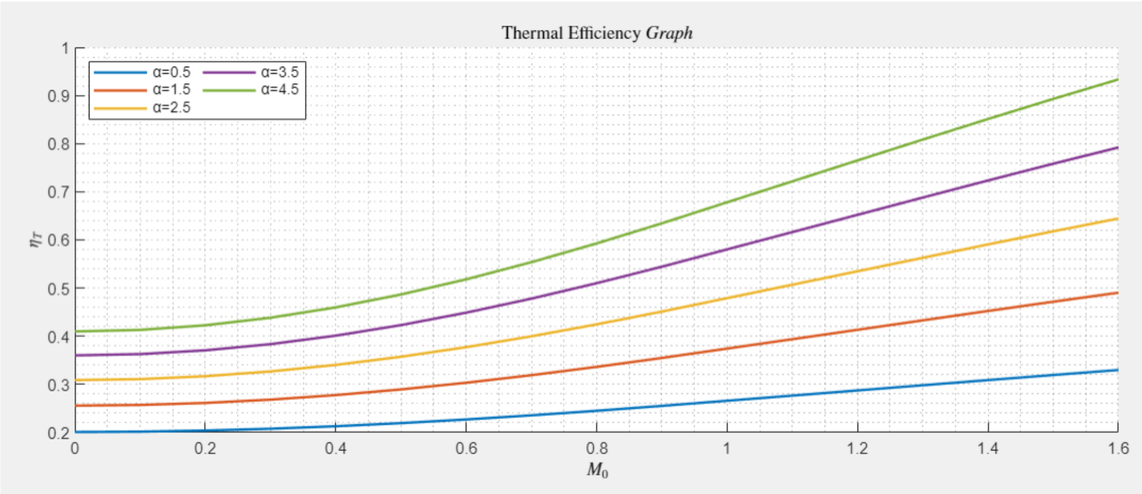

Figure 20 - Thermal Efficiency with Varying Different Bypass Ratios

In these graphs, the change of the thermal efficiency with varying Mach number, fan pressure ratio, compressor pressure ratio and by-pass number can be observed. With increasing Mach number the thermal efficiency is rising. The biggest increase in the thermal efficiency occurs with the rising by-pass number. Also, fan pressure ratio and compressor pressure ratio has a positive effect on the thermal efficiency due to less fuel need.

6.2.3. Overall Efficiensy

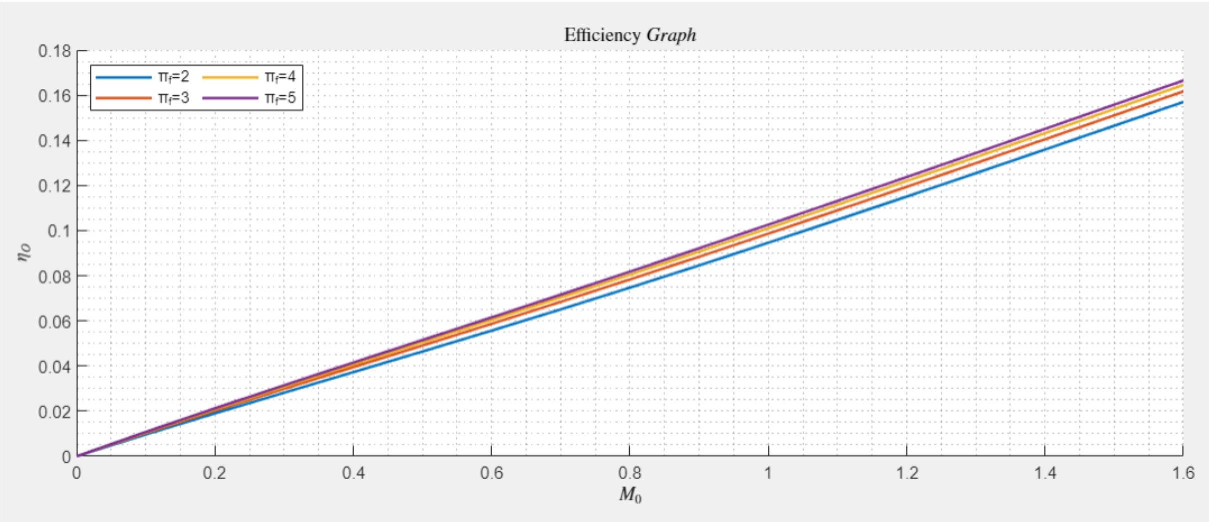

Figure 21 – Overall Efficiency For Different Fan Pressure Ratios

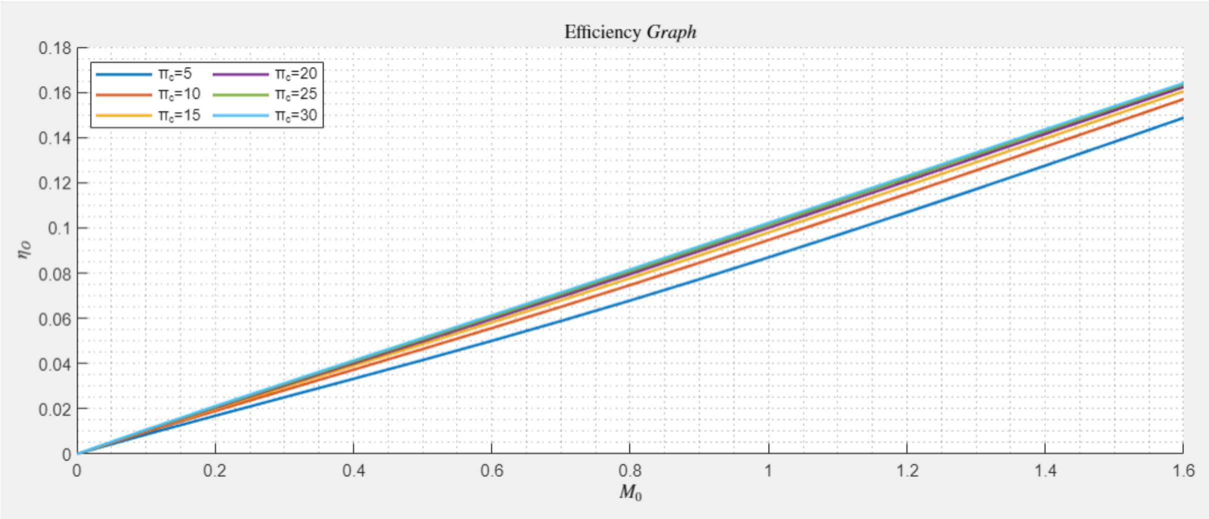

Figure 22 - Overall Efficiency For Different Compressor Pressure Ratios

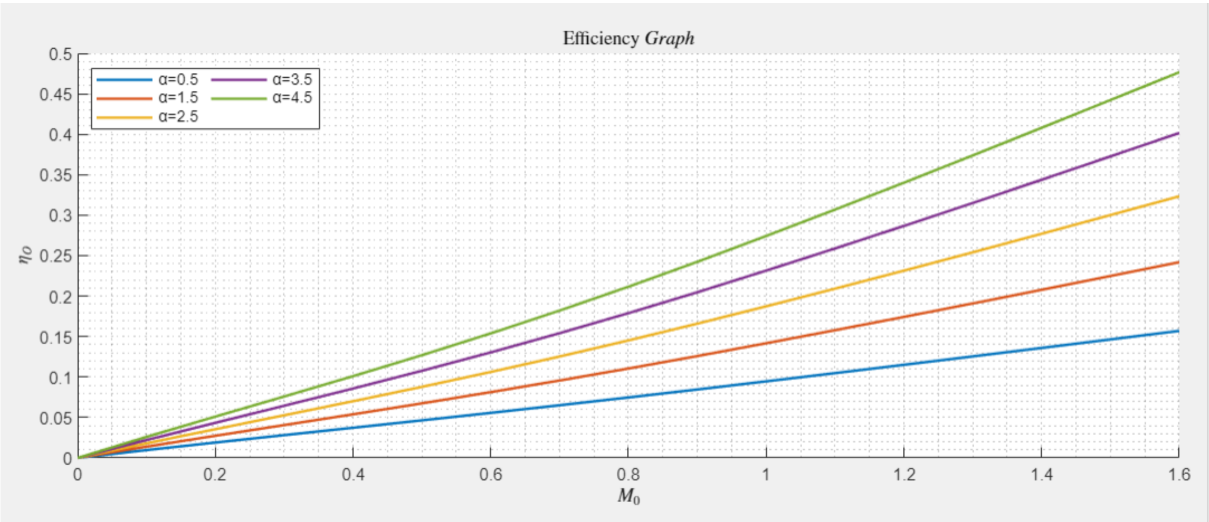

Figure 23 - Overall Efficiency For Different Bypass Ratios

The overall efficiency is mostly dominated by the propulsive efficiency and the Mach number. In the first two graphs, the maximum efficiency is about 0.16 for all fan pressure and compressor pressure ratios. But the by-pass number has a very significant effect on the overall efficiency because of the effects on the thermal efficiency and the overall efficiency reaches to 0.45 with a 4.5 by-pass ratio.

6.3. Outputs with Respect to Varying Bypass Ratio (α) and Fan Pressure Ratio (π_f)

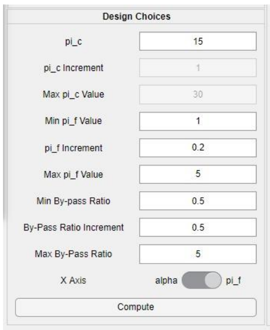

Figure 24 Design Choices

6.3.1. Specific Thrust

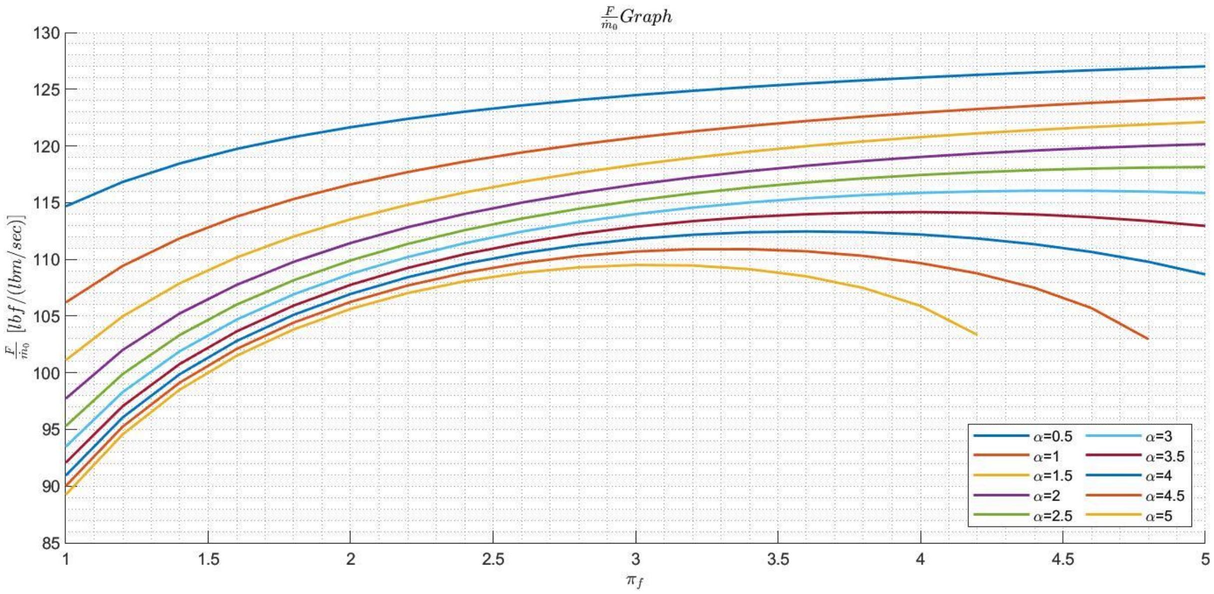

Figure 25 Specific Thrust

For lower bypass ratios, with rising pi f the air can be burned better due to better compression and the specific thrust obtained increases. At high bypass ratios, the power needed for the fan increases with rising fan pressure ratio, and the power which provides the propulsive force decreases. This power reduction causes the specific thrust to decrease.

For constant fan pressure ratio, specific thrust decreases with rising bypass ratio. Specific thrust is related to the engine size and generally has lower values.

6.3.2. Specific Fuel Consumption

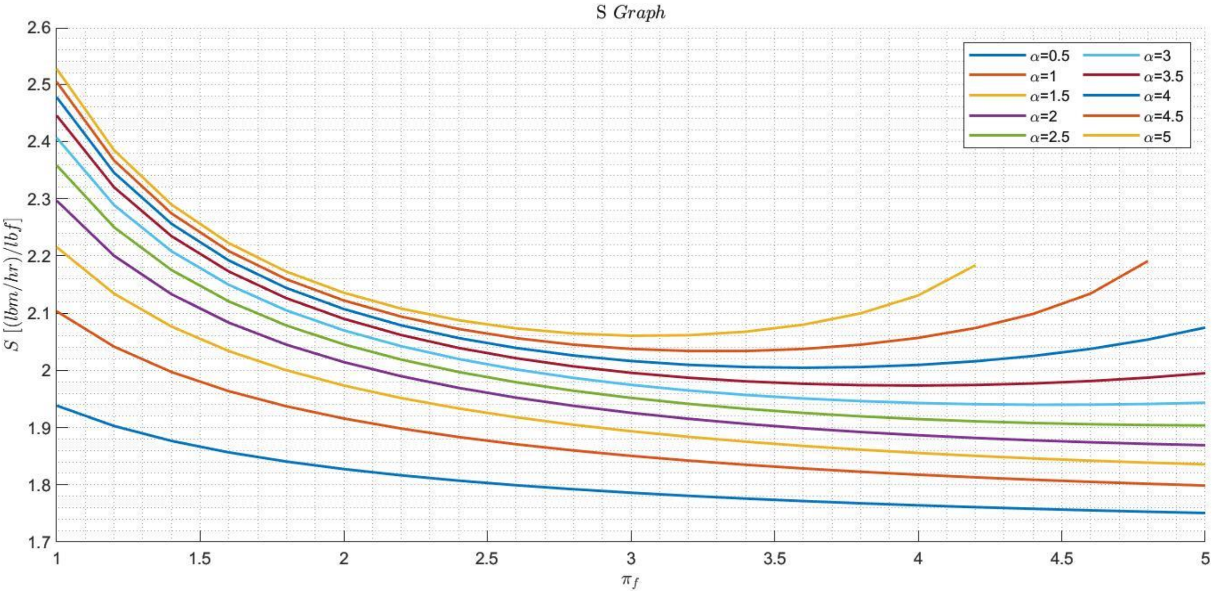

Figure 26 Specific Fuel Consumption

Specific fuel consumption is related to the specific thrust and behaves in the opposite way. The value of the specific thrust increases with the rising bypass ratio and decreasing fan pressure ratio.

We see that the SFC and specific thrust graphs have opposing characteristics as expected. Both graphs represent an optimum fan pressure ratio. This ratio is lower than the ones in ideal engine. Higher bypass ratios correspond to higher values of SFC and lower values of specific thrust. This contradict in theory because the graphs that are presented at this section belongs to a separate flow turbofan without an afterburner. In the case of separate flow turbofan engine with afterburner, the afterburner can burn higher amounts of fuel by the increment of bypass ratio.

If there is any odd behavior or imaginary solutions, the system indicates that a turbine fails to provide enough power to fan.

6.4. Outputs with Respect to Varying Bypass Ratio (α) and Mach Number (M_0)

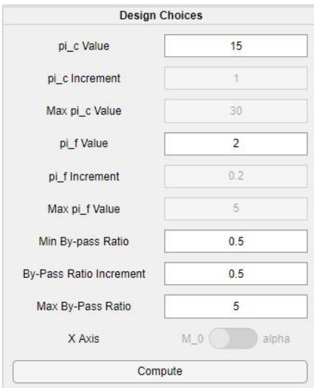

Figure 27 Design Choices

6.4.1. Specific Thrust

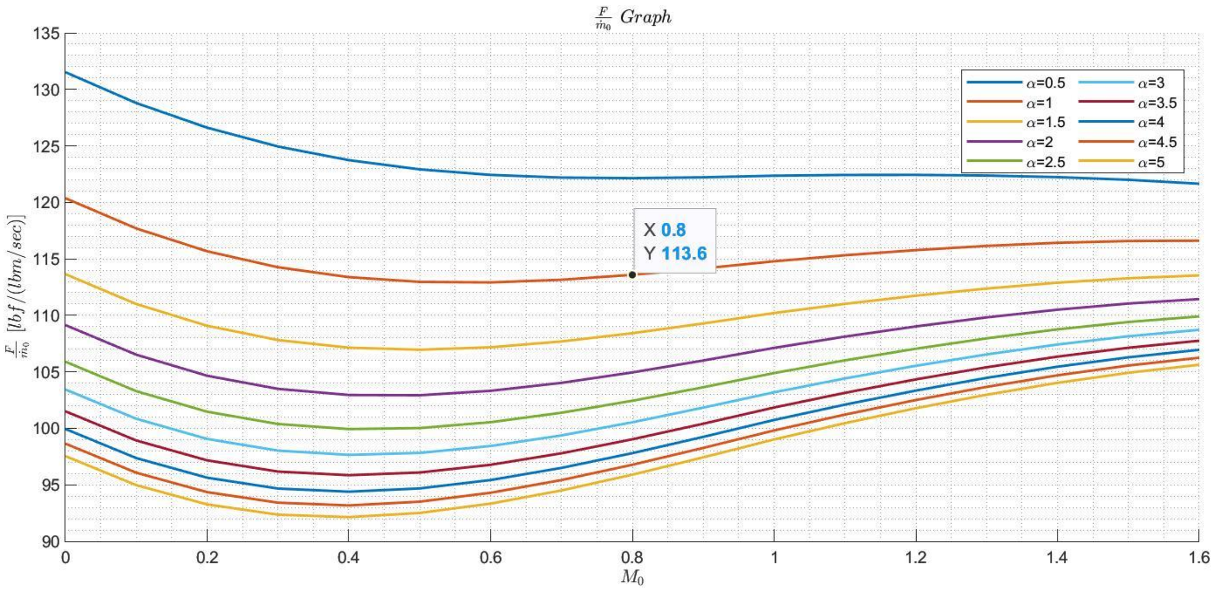

Figure 28 Specific Thrust

At constant bypass ratio, between 0 - 0.4 Mach, specific thrust decreases because flight Mach number rises and the exit velocity remains constant. After 0.4 Mach, ram pressure ratio increases with rising Mach number, and the total temperature of the air also increases. The augmentation of the total temperature causes the specific thrust to increase.

At constant Mach number, with a rising bypass ratio, the specific thrust decreases because of the growing engine size.

6.4.2. Specific Fuel Consumption

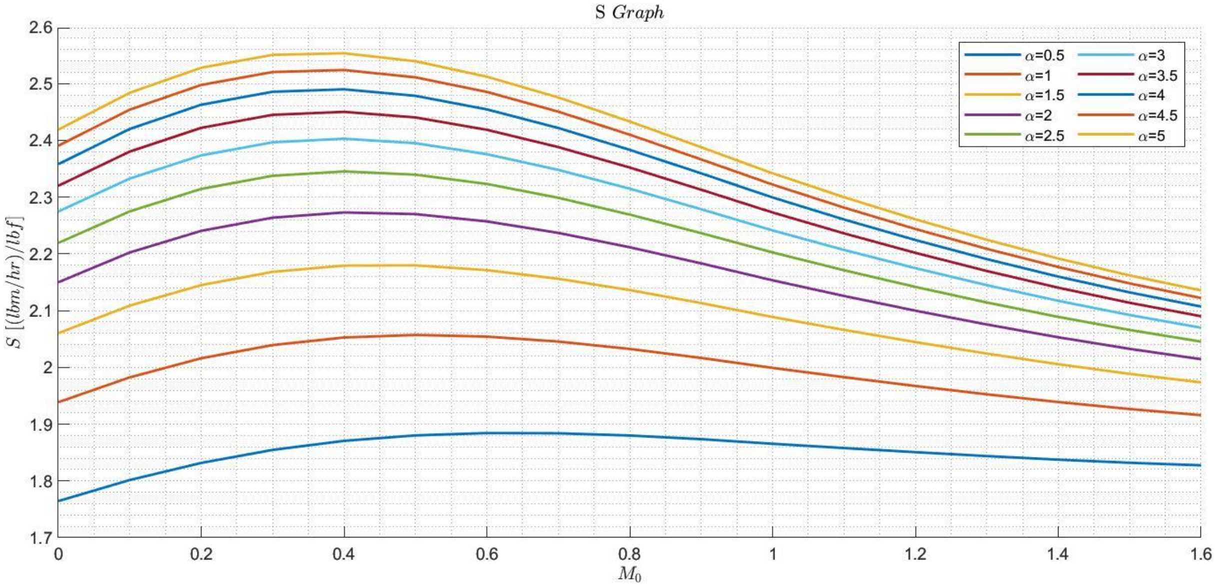

Figure 29 Specific Fuel Consumption

Specific fuel consumption is related to the specific thrust and behaves in the opposite way.

6.4. Outputs with Respect to Tt4, Tt7, Tt17 and Mach Number (M_0)

Figure 30 Design Choices

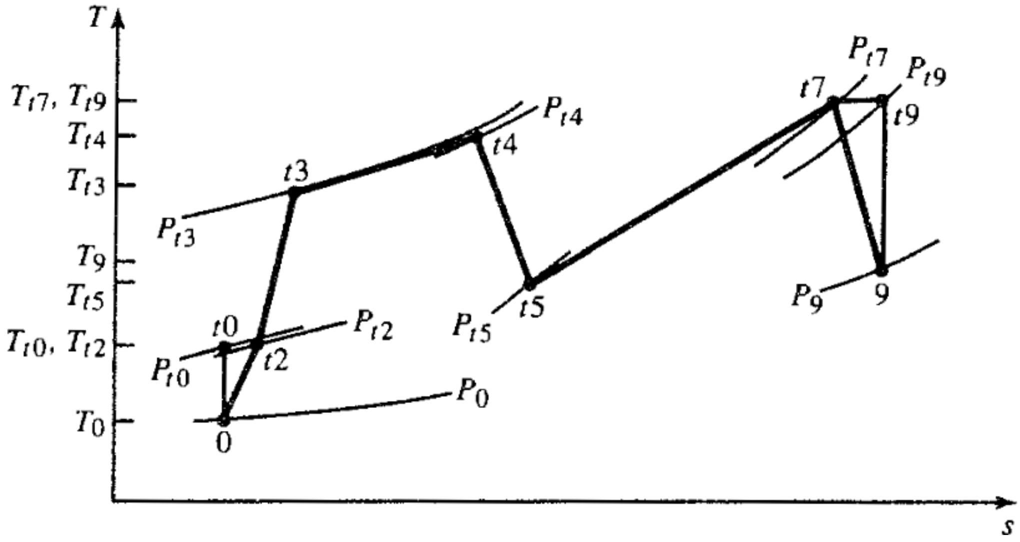

Figure 31 Brayton Cycle

The engine gains the force it needs mainly from the Tt4 and Tt7 temperature offset as it is plotted in Brayton Cycle. Tt4 is temperature after the combustion chamber and Tt7 is the temperature after the afterburner. If Tt4 temperature increases more fuel is burned and more thrust is generated as a result. Tt4 determines how much fuel that can be burned in the combustion chamber, hence it is a direct limitation on how much fuel that can be burned. Therefore, S decreases with increased Tt4. This can be seen in the following figures:

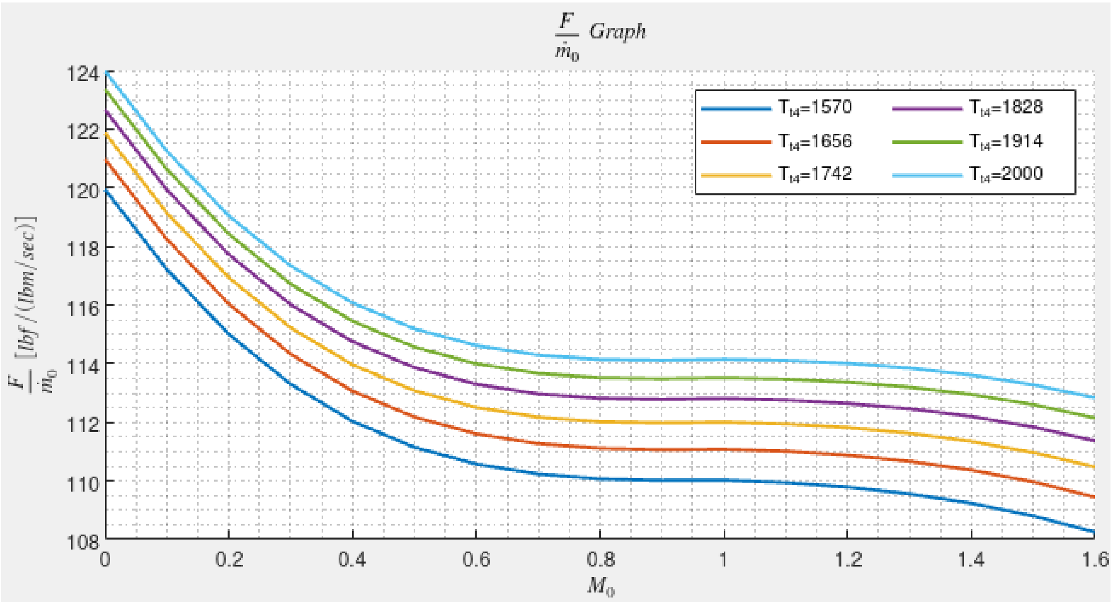

Figure 32 Specific Thrust

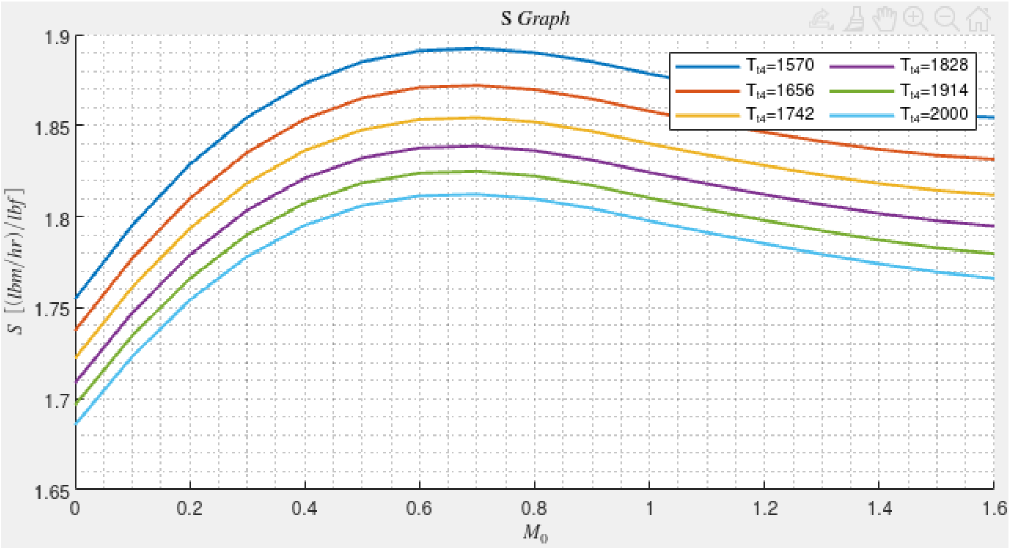

Figure 33 Specific Fuel Consumption

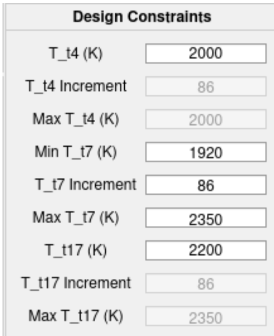

Figure 34 Design Choices

In the case of increased Tt7 temperature, the force is obviously increased. This ideology is related to the same Brayton Cycle principle explained above. To achieve more thrust, more fuel needs to be burned in the afterburner zone.

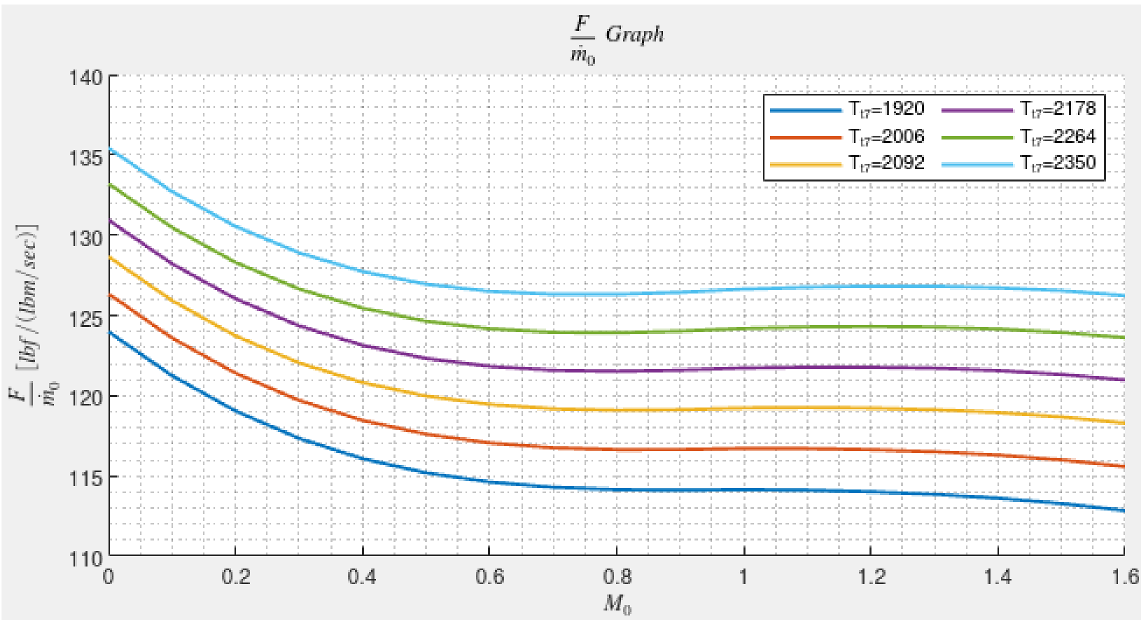

Figure 35 Specific Thrust

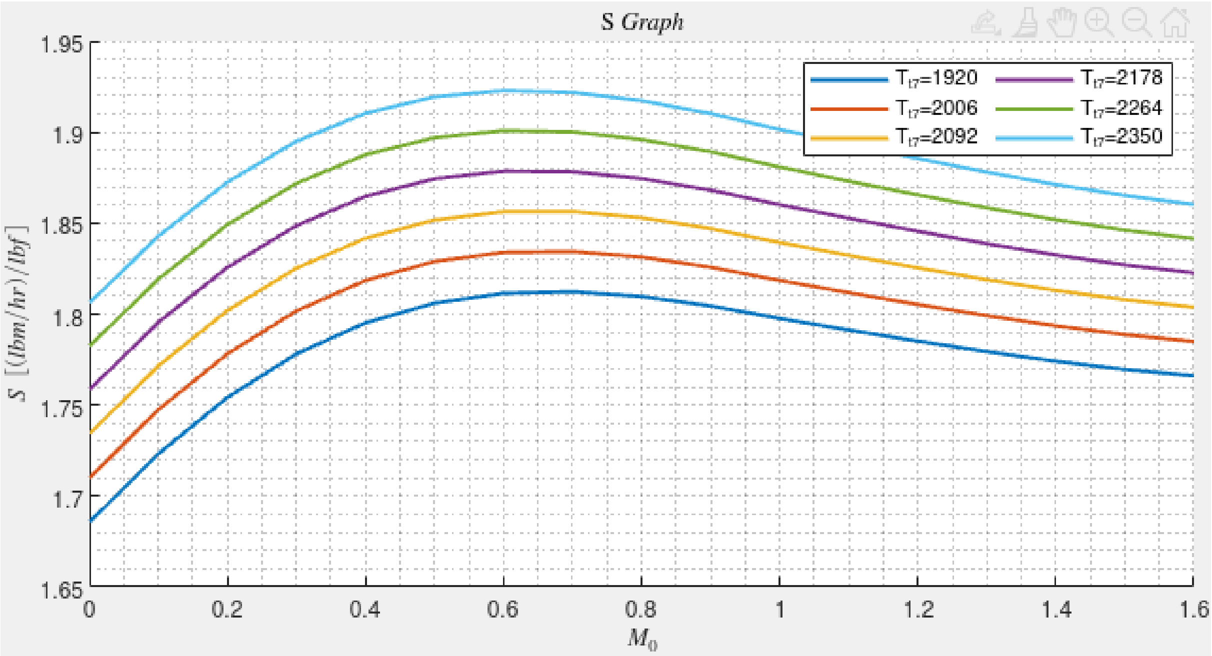

Figure 36 Specific Fuel Consumption

Tt17 belongs to the air that is just about to enter the duct nozzle area. For an increased Tt17 temperature, more fuel needs to be burned using the duct burner.

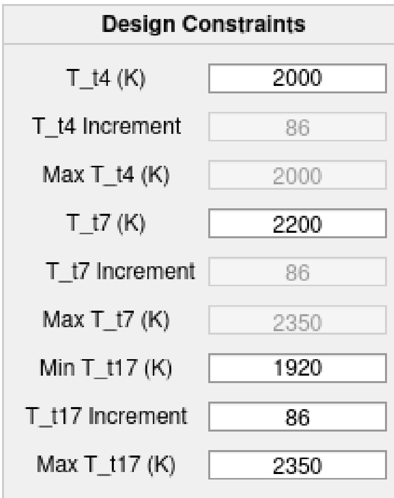

Figure 37Design Choices

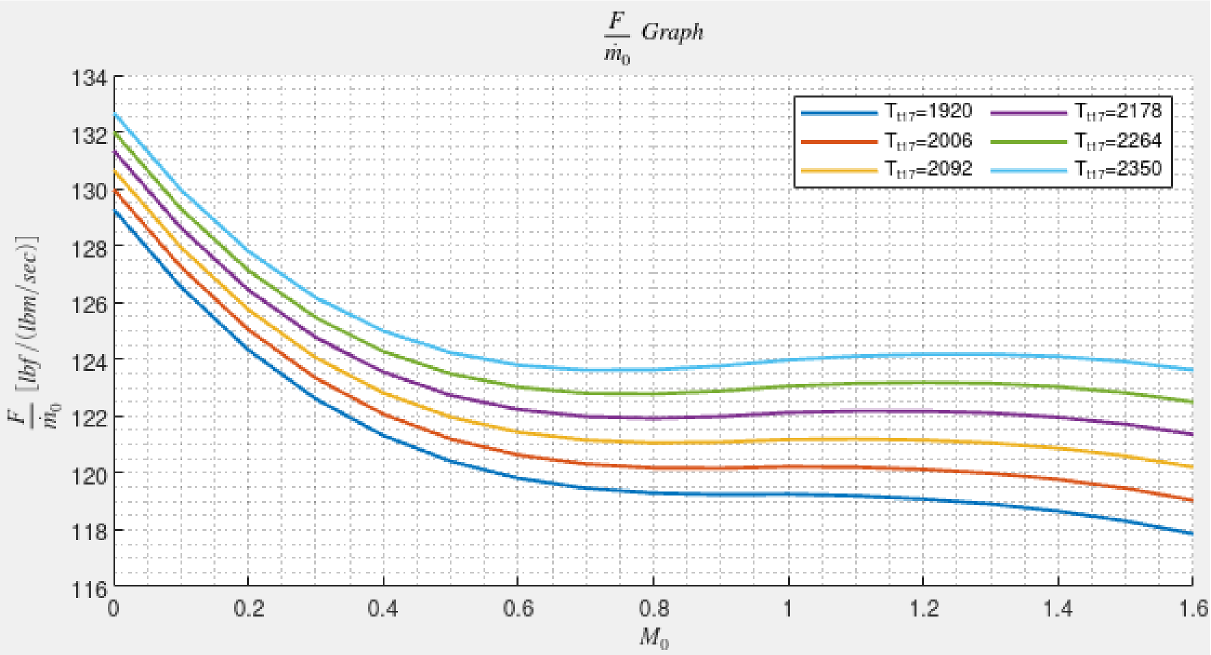

Figure 38 Specific Thrust

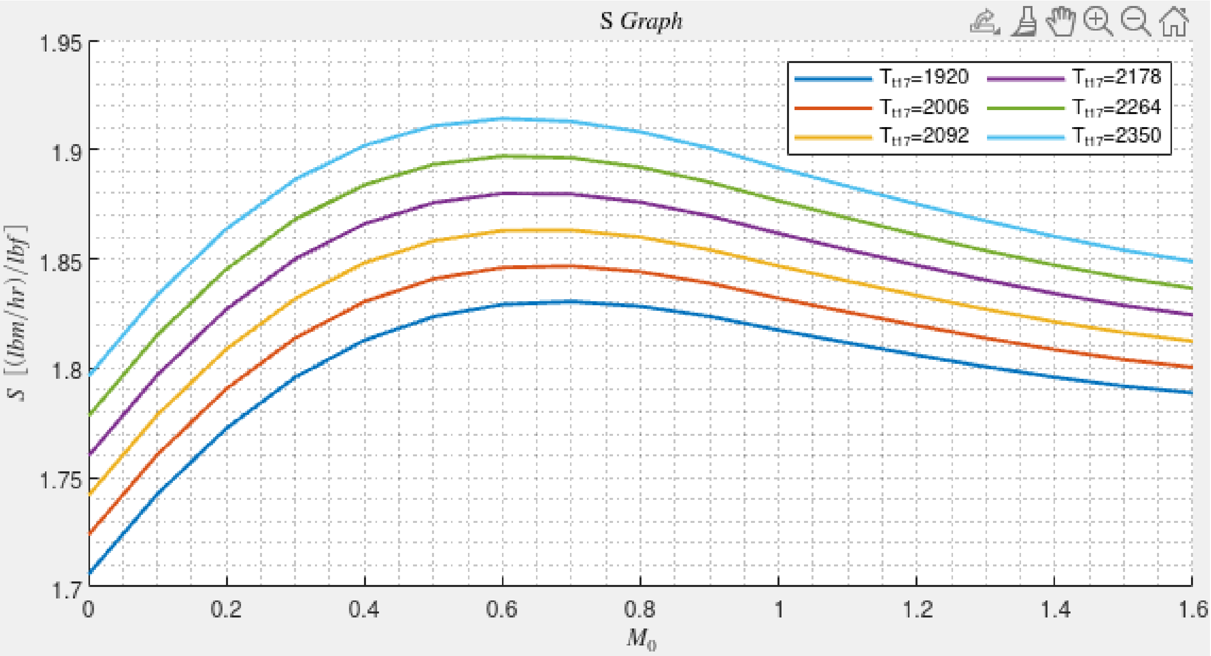

Figure 39 Specific Fuel Consumption

7. Conclusion

In this study Seperated Stream Afterburner Turbofan Engine is researched. MATLAB based Graphical User Interface for parametric cycle analysis is designed and validated by comparing the Reference Book. Ranges of design parameters and component performances of the engine is determined by past-designed engine specifications. Parametric cycle analysis is done via designed User Interface. Effects of the design parameters on engine performance are investigated and the results are discussed with detailed graphs.

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APPENDIX

Source code:

```
classdef SSATFv2_5 < matlab.apps.AppBase


    % Properties that correspond to app components
    properties (Access = public)
        AfterburnerTurbofan          matlab.ui.Figure
        FlightConditionsPanel        matlab.ui.container.Panel
        GridLayout                   matlab.ui.container.GridLayout
        T_0KEditFieldLabel           matlab.ui.control.Label
        T_0KEditField                matlab.ui.control.NumericEditField
        MachNumberEditFieldLabel     matlab.ui.control.Label
        MachNumberMinEditField       matlab.ui.control.NumericEditField
        P_0P_9EditFieldLabel         matlab.ui.control.Label
        P_0P_9EditField              matlab.ui.control.NumericEditField
        P_0P_19EditFieldLabel        matlab.ui.control.Label
```

```
P_0P_19EditField               matlab.ui.control.NumericEditField
gamma_cEditFieldLabel          matlab.ui.control.Label
gamma_cEditField               matlab.ui.control.NumericEditField
c_pckJkgKLabel                 matlab.ui.control.Label
c_pckJkgKEditField             matlab.ui.control.NumericEditField
MaxMachNumberEditFieldLabel    matlab.ui.control.Label
MaxMachNumberEditField         matlab.ui.control.NumericEditField
MachNoIncrementEditFieldLabel  matlab.ui.control.Label
MachNoIncrementEditField       matlab.ui.control.NumericEditField
TabGroup                       matlab.ui.container.TabGroup
Table                          matlab.ui.container.Tab
UITable                        matlab.ui.control.Table
Fm_0dotTab                     matlab.ui.container.Tab
FovermdotPlot                  matlab.ui.control.UIAxes
STab                           matlab.ui.container.Tab
SPlot                          matlab.ui.control.UIAxes
FuelAirRatioTab                matlab.ui.container.Tab
FuelPlot                       matlab.ui.control.UIAxes
Eta_cTab                       matlab.ui.container.Tab
eta_cPlot                      matlab.ui.control.UIAxes
Eta_tTab                       matlab.ui.container.Tab
eta_tPlot                      matlab.ui.control.UIAxes
PropulsiveEfficiencyTab        matlab.ui.container.Tab
GridLayout7                    matlab.ui.container.GridLayout
eta_pPlot                      matlab.ui.control.UIAxes
TermalEfficiencyTab            matlab.ui.container.Tab
eta_thermoPlot                 matlab.ui.control.UIAxes
OverallEfficiencyTab           matlab.ui.container.Tab
eta_oPlot                      matlab.ui.control.UIAxes
DesignConstraintsPanel         matlab.ui.container.Panel
GridLayout2                    matlab.ui.container.GridLayout
MinT_t4KLabel                  matlab.ui.control.Label
MinT_t4KEditField              matlab.ui.control.NumericEditField
MinT_t17KLabel                 matlab.ui.control.Label
MinT_t17KEditField             matlab.ui.control.NumericEditField
MinT_t7KLabel                  matlab.ui.control.Label
MinT_t7KEditField              matlab.ui.control.NumericEditField
T_t4IncrementEditFieldLabel    matlab.ui.control.Label
T_t4IncrementEditField         matlab.ui.control.NumericEditField
MaxT_t4KEditFieldLabel         matlab.ui.control.Label
MaxT_t4KEditField              matlab.ui.control.NumericEditField
T_t7IncrementEditFieldLabel    matlab.ui.control.Label
T_t7IncrementEditField         matlab.ui.control.NumericEditField
MaxT_t7KEditFieldLabel         matlab.ui.control.Label
MaxT_t7KEditField              matlab.ui.control.NumericEditField
T_t17IncrementEditFieldLabel   matlab.ui.control.Label
T_t17IncrementEditField        matlab.ui.control.NumericEditField
MaxT_t17KEditFieldLabel        matlab.ui.control.Label
MaxT_t17KEditField             matlab.ui.control.NumericEditField
ComponentPerformancesPanel     matlab.ui.container.Panel
GridLayout3                    matlab.ui.container.GridLayout
pi_bEditFieldLabel             matlab.ui.control.Label
pi_bEditField                  matlab.ui.control.NumericEditField
eta_ABEditFieldLabel           matlab.ui.control.Label
eta_ABEditField                matlab.ui.control.NumericEditField
eta_DBEditFieldLabel           matlab.ui.control.Label
eta_DBEditField                matlab.ui.control.NumericEditField
eta_mEditFieldLabel            matlab.ui.control.Label
eta_mEditField                 matlab.ui.control.NumericEditField
eta_bEditFieldLabel            matlab.ui.control.Label
eta_bEditField                 matlab.ui.control.NumericEditField
pi_DBEditFieldLabel            matlab.ui.control.Label
pi_DBEditField                 matlab.ui.control.NumericEditField
pi_d_maxEditFieldLabel         matlab.ui.control.Label
pi_d_maxEditField              matlab.ui.control.NumericEditField
```

```matlab
        e_cEditFieldLabel               matlab.ui.control.Label
        e_cEditField                    matlab.ui.control.NumericEditField
        e_tEditFieldLabel               matlab.ui.control.Label
        e_tEditField                    matlab.ui.control.NumericEditField
        e_fEditFieldLabel               matlab.ui.control.Label
        e_fEditField                    matlab.ui.control.NumericEditField
        pi_fnEditFieldLabel             matlab.ui.control.Label
        pi_fnEditField                  matlab.ui.control.NumericEditField
        pi_nEditFieldLabel              matlab.ui.control.Label
        pi_nEditField                   matlab.ui.control.NumericEditField
        pi_ABEditFieldLabel             matlab.ui.control.Label
        pi_ABEditField                  matlab.ui.control.NumericEditField
        CaseSelectionPanel              matlab.ui.container.Panel
        CaseDropDownLabel               matlab.ui.control.Label
        CaseDropDown                    matlab.ui.control.DropDown
        DesignChoicesPanel              matlab.ui.container.Panel
        GridLayout4                     matlab.ui.container.GridLayout
        ComputeButton                   matlab.ui.control.Button
        Minpi_cValueLabel               matlab.ui.control.Label
        Minpi_cValueEditField           matlab.ui.control.NumericEditField
        Minpi_fValueEditFieldLabel      matlab.ui.control.Label
        Minpi_fEditField                matlab.ui.control.NumericEditField
        Maxpi_fValueEditFieldLabel      matlab.ui.control.Label
        Maxpi_fEditField                matlab.ui.control.NumericEditField
        MinByPassRatioValueEditFieldLabel  matlab.ui.control.Label
        MinByPassRatioEditField         matlab.ui.control.NumericEditField
        MaxByPassRatioEditFieldLabel    matlab.ui.control.Label
        MaxByPassRatioEditField         matlab.ui.control.NumericEditField
        pi_fIncrementEditFieldLabel     matlab.ui.control.Label
        pi_fIncrementEditField          matlab.ui.control.NumericEditField
        ByPassRatioIncrementEditFieldLabel  matlab.ui.control.Label
        ByPassRatioIncrementEditField   matlab.ui.control.NumericEditField
        pi_cIncrementEditField_2Label   matlab.ui.control.Label
        pi_cIncrementEditField          matlab.ui.control.NumericEditField
        Maxpi_cValueEditField_2Label    matlab.ui.control.Label
        Maxpi_cValueEditField           matlab.ui.control.NumericEditField
        XAxisSwitchLabel                matlab.ui.control.Label
        XAxisSwitch                     matlab.ui.control.Switch
        GasPropertiesPanel              matlab.ui.container.Panel
        GridLayout5                     matlab.ui.container.GridLayout
        c_ptkJkgKEditFieldLabel         matlab.ui.control.Label
        c_ptkJkgKEditField              matlab.ui.control.NumericEditField
        c_pABkJkgKLabel                 matlab.ui.control.Label
        c_pABkJkgKEditField             matlab.ui.control.NumericEditField
        c_pDBkJkgKEditFieldLabel        matlab.ui.control.Label
        c_pDBkJkgKEditField             matlab.ui.control.NumericEditField
        gamma_ABEditFieldLabel          matlab.ui.control.Label
        gamma_ABEditField               matlab.ui.control.NumericEditField
        gamma_tEditFieldLabel           matlab.ui.control.Label
        gamma_tEditField                matlab.ui.control.NumericEditField
        gamma_DBEditFieldLabel          matlab.ui.control.Label
        gamma_DBEditField               matlab.ui.control.NumericEditField
        FuelPropertiesPanel             matlab.ui.container.Panel
        GridLayout6                     matlab.ui.container.GridLayout
        h_PRkJkgEditFieldLabel          matlab.ui.control.Label
        h_PRkJkgEditField               matlab.ui.control.NumericEditField
    end


    methods (Access = public)

        function [F__mdot_0,f,f_AB,f_DB,S,eta_c,eta_t,eta_f,eta_P,eta_T,eta_O] = ...
                ATFwithSeperateExhausts(app,M_0,T_0,gamma_c,c_pc,gamma_t,c_pt,h_PR,...
                gamma_AB,c_p_AB,gamma_DB,c_p_DB,pi_d_max,pi_b,pi_AB,pi_DB,pi_n,...
```

```
        pi_fn,e_c,e_f,e_t,eta_b,eta_AB,eta_DB,eta_m,P_0__P_9,P_0__P_19,...
        T_t4,T_t7,T_t17,pi_c,pi_f,alpha)

    % Calculations
    g_c = 1;
    R_c = ((gamma_c-1)./gamma_c).*c_pc; %
    R_t = ((gamma_t-1)./gamma_t).*c_pt; %
    R_AB = ((gamma_AB-1)./gamma_AB).*c_p_AB; %
    R_DB = ((gamma_DB-1)./gamma_DB).*c_p_DB; %
    a_0 = sqrt(gamma_c.*R_c.*g_c.*T_0*1000); % kJ den Joule'e gecis yapildi
    V_0 = a_0.*M_0;
    tau_r = 1 + (gamma_c-1)./2.*M_0.^2;
    pi_r = tau_r.^(gamma_c./(gamma_c-1));
    if M_0 <= 1
        eta_r = 1;
    else
        eta_r = 1 - 0.075*(M_0-1).^(1.35);
    end
    pi_d = pi_d_max.*eta_r;
    tau_lambda = (c_pt.*T_t4)./(c_pc.*T_0);
    tau_lambda_AB = (c_p_AB.*T_t7)./(c_pc.*T_0);
    tau_lambda_DB = (c_p_DB.*T_t17)./(c_pc.*T_0);
    tau_c = pi_c.^((gamma_c-1)./(gamma_c.*e_c));
    eta_c = (pi_c.^((gamma_c-1)./gamma_c)-1)./(tau_c-1);
    tau_f = pi_f.^((gamma_c-1)./(gamma_c.*e_f));
    eta_f = (pi_f.^((gamma_c-1)./gamma_c)-1)./(tau_f-1); %%%
    f = (tau_lambda-tau_r.*tau_c)./(eta_b.*h_PR./(c_pc.*T_0)-tau_lambda);
    tau_t = 1 - 1./(eta_m.*(1+f)).*(tau_r./tau_lambda).*(tau_c-1+alpha.*(tau_f-1));
    pi_t = tau_t.^(gamma_t./((gamma_t-1).*e_t));
    eta_t = (1-tau_t)./(1-tau_t.^(1./e_t));
    P_t9__P_9 = P_0__P_9.*pi_r.*pi_d.*pi_c.*pi_b.*pi_t.*pi_AB.*pi_n;
    M_9 = sqrt(2./(gamma_AB-1) .* (P_t9__P_9.^((gamma_AB-1)./gamma_AB) - 1));
    T_9__T_0 = T_t7./T_0./(P_t9__P_9.^((gamma_AB-1)./gamma_AB));
    V_9__a_0 = M_9.*sqrt(gamma_AB.*R_AB./gamma_c./R_c.*T_9__T_0);
    P_t19__P_19 = P_0__P_19.*pi_r.*pi_d.*pi_f.*pi_DB.*pi_fn;
    M_19 = sqrt(2./(gamma_DB-1) .* (P_t19__P_19.^((gamma_DB-1)./gamma_DB) - 1));
    T_19__T_0 = T_t17./T_0./(P_t19__P_19.^((gamma_DB-1)./gamma_DB));
    V_19__a_0 = M_19.*sqrt(gamma_DB.*R_DB./gamma_c./R_c.*T_19__T_0);
    f_AB = (1+f).*(tau_lambda_AB-tau_lambda.*tau_t)./(eta_AB.*h_PR./(c_pc*T_0)-
tau_lambda_AB);
    f_DB = (tau_lambda_DB-tau_r.*tau_f)./(eta_DB.*h_PR./(c_pc*T_0)-tau_lambda_DB);
    F__mdot_0 = 1./(1+alpha).*(a_0/g_c).*((1+f+f_AB).*V_9__a_0-M_0+(1+f+f_AB).*...
        R_AB./R_c.*(T_9__T_0)./(V_9__a_0).*(1-P_0__P_9)./(gamma_c))...
        +alpha./(1+alpha).*(a_0/g_c).*((1+f_DB).*V_19__a_0-M_0+(1+f_DB).*...
        R_DB./R_c.*(T_19__T_0)./(V_19__a_0).*(1-P_0__P_19)./(gamma_c));
    S = 10^6*(f+f_AB+alpha*f_DB)./(1+alpha)./(F__mdot_0);
    F__mdot_0 = F__mdot_0*0.224809/2.20462;
    S = S/0.2248089*3600*2.20462*10^(-6);
    eta_P = 2.*M_0.*((1+f+f_AB).*V_9__a_0+alpha.*(1+f_DB).*V_19__a_0-
(1+alpha).*M_0)./...
        ((1+f+f_AB).*V_9__a_0.^2+alpha.*(1+f_DB).*V_19__a_0.^2-(1+alpha).*M_0.^2);
    eta_T = (a_0.^2).*((1+f+f_AB).*V_9__a_0.^2+alpha.*(1+f_DB).*V_19__a_0.^2-
(1+alpha).*M_0.^2)./...
        (2.*g_c.*(f+f_AB+f_DB).*h_PR.*1000);
    eta_O = eta_T.*eta_P;
    if not(isreal(F__mdot_0)) && not(isreal(S))
        F__mdot_0 = NaN;
        f = NaN;
        f_AB = NaN;
        f_DB = NaN;
        S = NaN;
        eta_c = NaN;
        eta_t = NaN;
        eta_f = NaN;
        eta_P = NaN;
```

```matlab
                eta_T = NaN;
                eta_O = NaN;
            end
        end
    end



    % Callbacks that handle component events
    methods (Access = private)


        % Code that executes after component creation
        function startupFcn(app)
            set(app.MachNoIncrementEditField,'enable','off');
            set(app.MaxMachNumberEditField,'enable','off');
            set(app.pi_cIncrementEditField,'enable','off');
            set(app.Maxpi_cValueEditField,'enable','off');
            set(app.pi_fIncrementEditField,'enable','off');
            set(app.Maxpi_fEditField,'enable','off');
            set(app.ByPassRatioIncrementEditField,'enable','off');
            set(app.MaxByPassRatioEditField,'enable','off');
            set(app.T_t4IncrementEditField,'enable','off');
            set(app.MaxT_t4KEditField,'enable','off');
            set(app.T_t7IncrementEditField,'enable','off');
            set(app.MaxT_t7KEditField,'enable','off');
            set(app.T_t17IncrementEditField,'enable','off');
            set(app.MaxT_t17KEditField,'enable','off');
            app.Minpi_fValueEditFieldLabel.Text = 'pi_f';
            app.MinByPassRatioValueEditFieldLabel.Text = 'By-pass Ratio';
            app.Minpi_cValueLabel.Text = 'pi_c';
            app.MinT_t4KLabel.Text = 'T_t4 (K)';
            app.MinT_t7KLabel.Text = 'T_t7 (K)';
            app.MinT_t17KLabel.Text = 'T_t17 (K)';
            set(app.XAxisSwitch,'enable','off');

        end


        % Button pushed function: ComputeButton
        function ComputeButtonPushed(app, event)
            solverval = app.CaseDropDown.Value;
            xaxisval = app.XAxisSwitch.Value;
            % Resetting Graphs
            cla(app.FovermdotPlot,'reset');
            cla(app.SPlot,'reset');
            cla(app.FuelPlot,'reset');
            cla(app.eta_cPlot,'reset');
            cla(app.eta_tPlot,'reset');
            cla(app.eta_pPlot,"reset");
            cla(app.eta_thermoPlot,"reset");
            cla(app.eta_oPlot,"reset");

            % Taking Edit Field Value
            M_0_min = app.MachNumberMinEditField.Value;
            M_0_increment = app.MachNoIncrementEditField.Value;
            M_0_max = app.MaxMachNumberEditField.Value;
            T_0 = app.T_0KEditField.Value;
            gamma_c = app.gamma_cEditField.Value;
            c_pc = app.c_pckJkgKEditField.Value;
            gamma_t = app.gamma_tEditField.Value;
            c_pt = app.c_ptkJkgKEditField.Value;
            h_PR = app.h_PRkJkgEditField.Value;
            gamma_AB = app.gamma_ABEditField.Value;
            c_p_AB = app.c_pABkJkgKEditField.Value;
```

```
            gamma_DB = app.gamma_DBEditField.Value;
            c_p_DB = app.c_pDBkJkgKEditField.Value;
            pi_d_max = app.pi_d_maxEditField.Value;
            pi_b = app.pi_bEditField.Value;
            pi_AB = app.pi_ABEditField.Value;
            pi_DB = app.pi_DBEditField.Value;
            pi_n = app.pi_nEditField.Value;
            pi_fn = app.pi_fnEditField.Value;
            e_c = app.e_cEditField.Value;
            e_f = app.e_fEditField.Value;
            e_t = app.e_tEditField.Value;
            eta_b = app.eta_bEditField.Value;
            eta_AB = app.eta_ABEditField.Value;
            eta_DB = app.eta_DBEditField.Value;
            eta_m = app.eta_mEditField.Value;
            P_0__P_9 = app.P_0P_9EditField.Value;
            P_0__P_19 = app.P_0P_19EditField.Value;

            T_t4_min = app.MinT_t4KEditField.Value;
            T_t4_increment = app.T_t4IncrementEditField.Value;
            T_t4_max = app.MaxT_t4KEditField.Value;

            T_t7_min = app.MinT_t7KEditField.Value;
            T_t7_increment = app.T_t7IncrementEditField.Value;
            T_t7_max = app.MaxT_t7KEditField.Value;

            T_t17_min = app.MinT_t17KEditField.Value;
            T_t17_increment = app.T_t17IncrementEditField.Value;
            T_t17_max = app.MaxT_t17KEditField.Value;

            alpha_min = app.MinByPassRatioEditField.Value;
            alpha_max = app.MaxByPassRatioEditField.Value;
            alpha_increment = app.ByPassRatioIncrementEditField.Value;
            pi_f_min = app.Minpi_fEditField.Value;
            pi_f_increment = app.pi_fIncrementEditField.Value;
            pi_f_max = app.Maxpi_fEditField.Value;
            pi_c_min = app.Minpi_cValueEditField.Value;
            pi_c_increment = app.pi_cIncrementEditField.Value;
            pi_c_max = app.Maxpi_cValueEditField.Value;



            switch solverval
                case 'Single Condition'
                    M_0 = M_0_min;
                    pi_c = pi_c_min;
                    pi_f = pi_f_min;
                    alpha = alpha_min;
                    T_t4 = T_t4_min;
                    T_t7 = T_t7_min;
                    T_t17 = T_t17_min;

                    [F__mdot_0,f,f_AB,f_DB,S,eta_c,eta_t,eta_f,eta_P,eta_T,eta_O] = ...
ATFwithSeperateExhausts(app,M_0,T_0,gamma_c,c_pc,gamma_t,c_pt,h_PR,...
                        gamma_AB,c_p_AB,gamma_DB,c_p_DB,pi_d_max,pi_b,pi_AB,pi_DB,pi_n,...
                        pi_fn,e_c,e_f,e_t,eta_b,eta_AB,eta_DB,eta_m,P_0__P_9,P_0__P_19,...
                        T_t4,T_t7,T_t17,pi_c,pi_f,alpha);

                    % Creating Table
                    t =
table(M_0,pi_c,pi_f,alpha,T_t4,T_t7,T_t17,F__mdot_0,f,f_AB,f_DB,S,eta_c,eta_t,eta_f,eta_P,e
ta_T,eta_O);
                    app.UITable.Data = t;
```

```
                    vars =
{'M_0','pi_c','pi_f','alpha','T_t4','T_t7','T_t17','F__mdot_0','f','f_AB','f_DB','S','eta_c
','eta_t','eta_f','eta_P','eta_T','eta_O'};
                    app.UITable.ColumnName = vars;

                case 'Varying Bypass and pi_f'
                    M_0 = M_0_min;
                    pi_c = pi_c_min;
                    T_t4 = T_t4_min;
                    T_t7 = T_t7_min;
                    T_t17 = T_t17_min;
                    pi_f = pi_f_min:pi_f_increment:pi_f_max;
                    alpha = alpha_min:alpha_increment:alpha_max;
                    tablo = zeros(length(pi_f)*length(alpha),18);


                    for i = 1:length(pi_f)
                        for j=1:length(alpha)

[F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,
j),eta_T(i,j),eta_O(i,j)] = ...

ATFwithSeperateExhausts(app,M_0,T_0,gamma_c,c_pc,gamma_t,c_pt,h_PR,...

gamma_AB,c_p_AB,gamma_DB,c_p_DB,pi_d_max,pi_b,pi_AB,pi_DB,pi_n,...

pi_fn,e_c,e_f,e_t,eta_b,eta_AB,eta_DB,eta_m,P_0__P_9,P_0__P_19,...
                                T_t4,T_t7,T_t17,pi_c,pi_f(i),alpha(j));

                            tablo(length(alpha)*(i-1)+j,:) = ...
                                [M_0,pi_c,pi_f(i),alpha(j),T_t4,T_t7,T_t17,...

F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,j
),eta_T(i,j),eta_O(i,j)];

                        end
                    end
                    % Creating Table
                    t =
table(tablo(:,1),tablo(:,2),tablo(:,3),tablo(:,4),tablo(:,5),tablo(:,6),tablo(:,7),...

tablo(:,8),tablo(:,9),tablo(:,10),tablo(:,11),tablo(:,12),tablo(:,13),tablo(:,14),...
                        tablo(:,15),tablo(:,16),tablo(:,17),tablo(:,18));
                    app.UITable.Data = t;
                    vars =
{'M_0','pi_c','pi_f','alpha','T_t4','T_t7','T_t17','F__mdot_0','f','f_AB','f_DB','S','eta_c
','eta_t','eta_f','eta_P','eta_T','eta_O'};
                    app.UITable.ColumnName = vars;

                    % Handling Plots
                    switch xaxisval
                        case 'pi_f'

                            plot(app.FovermdotPlot,pi_f,F__mdot_0(:,:),"LineWidth",1.4)
                            title(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}
Graph$","Interpreter","Latex")
                            grid(app.FovermdotPlot,'minor')
                            xlabel(app.FovermdotPlot,"$\pi_f$","Interpreter","Latex");
                            ylabel(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
[lbf/(lbm/sec)]$","Interpreter","Latex");

legend(app.FovermdotPlot,'\alpha='+string(alpha),'Location','southeast','NumColumns',2);

                            plot(app.SPlot,pi_f,S(:,:),"LineWidth",1.4)
                            title(app.SPlot,"S $Graph$","Interpreter","Latex")
```

```
                            grid(app.SPlot,'minor')
                            xlabel(app.SPlot,"$\pi_f$","Interpreter","Latex");
                            ylabel(app.SPlot,"$S\ [(lbm/hr)/lbf]$","Interpreter","Latex");

legend(app.SPlot,'\alpha='+string(alpha),'Location','northeast','NumColumns',2);


plot(app.FuelPlot,pi_f,f(:,1),pi_f,f_AB(:,:),pi_f,f_DB(:,1),"LineWidth",1.4);
                            title(app.FuelPlot,"Fuel $Graph$","Interpreter","Latex")
                            grid(app.FuelPlot,'minor')
                            xlabel(app.FuelPlot,"$\pi_f$","Interpreter","Latex");
                            ylabel(app.FuelPlot,"$f,f_{AB},f_{DB}$","Interpreter","Latex");
                            leg = ['f for all \alpha','f_AB for
\alpha='+string(alpha),'f_DB for all \alpha'];
                            legend(app.FuelPlot,leg,'Location','northwest','NumColumns',2);

                            plot(app.eta_cPlot,pi_f,eta_c(:,:),"LineWidth",1.4)
                            title(app.eta_cPlot,"$\eta_c$ $Graph$","Interpreter","Latex")
                            grid(app.eta_cPlot,'minor')
                            xlabel(app.eta_cPlot,"$\pi_f$","Interpreter","Latex");
                            ylabel(app.eta_cPlot,"$\eta_c$","Interpreter","Latex");

legend(app.eta_cPlot,'\alpha='+string(alpha),'Location','northeast','NumColumns',2);

                            plot(app.eta_tPlot,pi_f,eta_t(:,:),"LineWidth",1.4)
                            title(app.eta_tPlot,"$\eta_t$","Interpreter","Latex")
                            grid(app.eta_tPlot,'minor')
                            xlabel(app.eta_tPlot,"$\pi_f$","Interpreter","Latex");
                            ylabel(app.eta_tPlot,"$\eta_t Graph$","Interpreter","Latex");

legend(app.eta_tPlot,'\alpha='+string(alpha),'Location','northeast','NumColumns',2);

                            plot(app.eta_pPlot,pi_f,eta_P(:,:),"LineWidth",1.4);
                            title(app.eta_pPlot," Propulsive Efficiency
$Graph$","Interpreter","Latex")
                            grid(app.eta_pPlot,'minor')
                            xlabel(app.eta_pPlot,"$ \pi_f $","Interpreter","Latex");
                            ylabel(app.eta_pPlot,"$\eta_P$","Interpreter","Latex");

legend(app.eta_pPlot,'\alpha='+string(alpha),'Location','northwest','NumColumns',2);

                            plot(app.eta_thermoPlot,pi_f,eta_T(:,:),"LineWidth",1.4);
                            title(app.eta_thermoPlot,"Thermal Efficiency
$Graph$","Interpreter","Latex")
                            grid(app.eta_thermoPlot,'minor')
                            xlabel(app.eta_thermoPlot,"$ \pi_f $","Interpreter","Latex");
                            ylabel(app.eta_thermoPlot,"$\eta_T$","Interpreter","Latex");

legend(app.eta_thermoPlot,'\alpha='+string(alpha),'Location','northwest','NumColumns',2);

                            plot(app.eta_oPlot,pi_f,eta_O(:,:),"LineWidth",1.4);
                            title(app.eta_oPlot,"Efficiency $Graph$","Interpreter","Latex")
                            grid(app.eta_oPlot,'minor')
                            xlabel(app.eta_oPlot,"$ \pi_f $","Interpreter","Latex");
                            ylabel(app.eta_oPlot,"$\eta_O$","Interpreter","Latex");

legend(app.eta_oPlot,'\alpha='+string(alpha),'Location','northwest','NumColumns',2);

                        case 'alpha'
                            plot(app.FovermdotPlot,alpha,F__mdot_0(:,:),"LineWidth",1.4)
                            title(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}
Graph$","Interpreter","Latex")
                            grid(app.FovermdotPlot,'minor')
                            xlabel(app.FovermdotPlot,"$\alpha$","Interpreter","Latex");
```

```
                            ylabel(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
[lbf/(lbm/sec)]$","Interpreter","Latex");

legend(app.FovermdotPlot,'\pi_f='+string(pi_f),'Location','southeast','NumColumns',2);

                            plot(app.SPlot,alpha,S(:,:),"LineWidth",1.4)
                            title(app.SPlot,"S $Graph$","Interpreter","Latex")
                            grid(app.SPlot,'minor')
                            xlabel(app.SPlot,"$\alpha$","Interpreter","Latex");
                            ylabel(app.SPlot,"$S\ [(lbm/hr)/lbf]$","Interpreter","Latex");

legend(app.SPlot,'\pi_f='+string(pi_f),'Location','northeast','NumColumns',2);


plot(app.FuelPlot,alpha,f(:,:),alpha,f_AB(:,:),alpha,f_DB(:,:),"LineWidth",1.4);
                            title(app.FuelPlot,"Fuel $Graph$","Interpreter","Latex")
                            grid(app.FuelPlot,'minor')
                            xlabel(app.FuelPlot,"$\alpha$","Interpreter","Latex");
                            ylabel(app.FuelPlot,"$f,f_{AB},f_{DB}$","Interpreter","Latex");
                            leg = ['f for \pi_f='+string(pi_f),'f_AB for
\pi_f='+string(pi_f),'f_DB for \pi_f='+string(pi_f)];
                            legend(app.FuelPlot,leg,'Location','northwest','NumColumns',2);

                            plot(app.eta_cPlot,alpha,eta_c(:,:),"LineWidth",1.4)
                            title(app.eta_cPlot,"$\eta_c$ $Graph$","Interpreter","Latex")
                            grid(app.eta_cPlot,'minor')
                            xlabel(app.eta_cPlot,"$\alpha$","Interpreter","Latex");
                            ylabel(app.eta_cPlot,"$\eta_c$","Interpreter","Latex");

legend(app.eta_cPlot,'\pi_f='+string(pi_f),'Location','northeast','NumColumns',2);

                            plot(app.eta_tPlot,alpha,eta_t(:,:),"LineWidth",1.4)
                            title(app.eta_tPlot,"$\eta_t$","Interpreter","Latex")
                            grid(app.eta_tPlot,'minor')
                            xlabel(app.eta_tPlot,"$\alpha$","Interpreter","Latex");
                            ylabel(app.eta_tPlot,"$\eta_t Graph$","Interpreter","Latex");

legend(app.eta_tPlot,'\pi_f='+string(pi_f),'Location','northeast','NumColumns',2);

                            plot(app.eta_pPlot,alpha,eta_P(:,:),"LineWidth",1.4);
                            title(app.eta_pPlot," Propulsive Efficiency
$Graph$","Interpreter","Latex")
                            grid(app.eta_pPlot,'minor')
                            xlabel(app.eta_pPlot,"$ \alpha $","Interpreter","Latex");
                            ylabel(app.eta_pPlot,"$\eta_P$","Interpreter","Latex");

legend(app.eta_pPlot,'\pi_f='+string(pi_f),'Location','northwest','NumColumns',2);

                            plot(app.eta_thermoPlot,alpha,eta_T(:,:),"LineWidth",1.4);
                            title(app.eta_thermoPlot,"Thermal Efficiency
$Graph$","Interpreter","Latex")
                            grid(app.eta_thermoPlot,'minor')
                            xlabel(app.eta_thermoPlot,"$ \alpha $","Interpreter","Latex");
                            ylabel(app.eta_thermoPlot,"$\eta_T$","Interpreter","Latex");

legend(app.eta_thermoPlot,'\pi_f='+string(pi_f),'Location','northwest','NumColumns',2);

                            plot(app.eta_oPlot,alpha,eta_O(:,:),"LineWidth",1.4);
                            title(app.eta_oPlot,"Efficiency $Graph$","Interpreter","Latex")
                            grid(app.eta_oPlot,'minor')
                            xlabel(app.eta_oPlot,"$ \alpha $","Interpreter","Latex");
                            ylabel(app.eta_oPlot,"$\eta_O$","Interpreter","Latex");

legend(app.eta_oPlot,'\pi_f='+string(pi_f),'Location','northwest','NumColumns',2);
```

```
                    end
                case 'Varying pi_f and pi_c'
                    alpha = alpha_min;
                    M_0 = M_0_min;
                    T_t4 = T_t4_min;
                    T_t7 = T_t7_min;
                    T_t17 = T_t17_min;
                    pi_f = pi_f_min:pi_f_increment:pi_f_max;
                    pi_c = pi_c_min:pi_c_increment:pi_c_max;
                    tablo = zeros(length(pi_f)*length(pi_c),18);


                    for i = 1:length(pi_f)
                        for j=1:length(pi_c)

[F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,
j),eta_T(i,j),eta_O(i,j)] = ...

ATFwithSeperateExhausts(app,M_0,T_0,gamma_c,c_pc,gamma_t,c_pt,h_PR,...

gamma_AB,c_p_AB,gamma_DB,c_p_DB,pi_d_max,pi_b,pi_AB,pi_DB,pi_n,...

pi_fn,e_c,e_f,e_t,eta_b,eta_AB,eta_DB,eta_m,P_0__P_9,P_0__P_19,...
                                T_t4,T_t7,T_t17,pi_c(j),pi_f(i),alpha);

                            tablo(length(pi_c)*(i-1)+j,:) = ...
                                [M_0,pi_c(j),pi_f(i),alpha,T_t4,T_t7,T_t17,...

F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,j
),eta_T(i,j),eta_O(i,j)];

                        end
                    end

                    % Creating Table
                    t =
table(tablo(:,1),tablo(:,2),tablo(:,3),tablo(:,4),tablo(:,5),tablo(:,6),tablo(:,7),...

tablo(:,8),tablo(:,9),tablo(:,10),tablo(:,11),tablo(:,12),tablo(:,13),tablo(:,14),...
                        tablo(:,15),tablo(:,16),tablo(:,17),tablo(:,18));
                    app.UITable.Data = t;
                    vars =
{'M_0','pi_c','pi_f','alpha','T_t4','T_t7','T_t17','F__mdot_0','f','f_AB','f_DB','S','eta_c
','eta_t','eta_f','eta_P','eta_T','eta_O'};
                    app.UITable.ColumnName = vars;
                    switch xaxisval
                        case 'pi_c'
                            % Handling Plots

                            plot(app.FovermdotPlot,pi_c,F__mdot_0(:,:),"LineWidth",1.4)
                            title(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
Graph$","Interpreter","Latex")
                            grid(app.FovermdotPlot,'minor')
                            xlabel(app.FovermdotPlot,"$\pi_c$","Interpreter","Latex");
                            ylabel(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
[lbf/(lbm/sec)]$","Interpreter","Latex");

legend(app.FovermdotPlot,'\pi_f='+string(pi_f),'Location','southeast','NumColumns',2);

                            plot(app.SPlot,pi_c,S(:,:),"LineWidth",1.4)
                            title(app.SPlot,"S $Graph$","Interpreter","Latex")
                            grid(app.SPlot,'minor')
                            xlabel(app.SPlot,"$\pi_c$","Interpreter","Latex");
                            ylabel(app.SPlot,"$S\ [(lbm/hr)/lbf]$","Interpreter","Latex");
```

```
legend(app.SPlot,'\pi_f='+string(pi_f),'Location','northeast','NumColumns',2);

                            p =
plot(app.FuelPlot,pi_c,f(1,:),pi_c,f_AB(:,:),pi_c,f_DB(:,:),"LineWidth",1.4);
                            title(app.FuelPlot,"Fuel $Graph$","Interpreter","Latex")
                            grid(app.FuelPlot,'minor')
                            xlabel(app.FuelPlot,"$\pi_c$","Interpreter","Latex");
                            ylabel(app.FuelPlot,"$f,f_{AB},f_{DB}$","Interpreter","Latex");
                            leg = ['f for all \pi_f','f_{AB} for
\pi_f='+string(pi_f),'f_{DB} for \pi_f='+string(pi_f)];
                            legend(app.FuelPlot,leg,'Location','northwest','NumColumns',2);

                            plot(app.eta_cPlot,pi_c,eta_c(:,:),"LineWidth",1.4)
                            title(app.eta_cPlot,"$\eta_c$ $Graph$","Interpreter","Latex")
                            grid(app.eta_cPlot,'minor')
                            xlabel(app.eta_cPlot,"$\pi_c$","Interpreter","Latex");
                            ylabel(app.eta_cPlot,"$\eta_c$","Interpreter","Latex");

legend(app.eta_cPlot,'\pi_f='+string(pi_f),'Location','northeast','NumColumns',2);

                            plot(app.eta_tPlot,pi_c,eta_t(:,:),"LineWidth",1.4)
                            title(app.eta_tPlot,"$\eta_t$","Interpreter","Latex")
                            grid(app.eta_tPlot,'minor')
                            xlabel(app.eta_tPlot,"$\pi_c$","Interpreter","Latex");
                            ylabel(app.eta_tPlot,"$\eta_t Graph$","Interpreter","Latex");

legend(app.eta_tPlot,'\pi_f='+string(pi_f),'Location','northeast','NumColumns',2);

                            plot(app.eta_pPlot,pi_c,eta_P(:,:),"LineWidth",1.4);
                            title(app.eta_pPlot," Propulsive Efficiency
$Graph$","Interpreter","Latex")
                            grid(app.eta_pPlot,'minor')
                            xlabel(app.eta_pPlot,"$ \pi_c $","Interpreter","Latex");
                            ylabel(app.eta_pPlot,"$\eta_P$","Interpreter","Latex");

legend(app.eta_pPlot,'\pi_f='+string(pi_f),'Location','northwest','NumColumns',2);

                            plot(app.eta_thermoPlot,pi_c,eta_T(:,:),"LineWidth",1.4);
                            title(app.eta_thermoPlot,"Thermal Efficiency
$Graph$","Interpreter","Latex")
                            grid(app.eta_thermoPlot,'minor')
                            xlabel(app.eta_thermoPlot,"$ \pi_c $","Interpreter","Latex");
                            ylabel(app.eta_thermoPlot,"$\eta_T$","Interpreter","Latex");

legend(app.eta_thermoPlot,'\pi_f='+string(pi_f),'Location','northwest','NumColumns',2);

                            plot(app.eta_oPlot,pi_c,eta_O(:,:),"LineWidth",1.4);
                            title(app.eta_oPlot,"Efficiency $Graph$","Interpreter","Latex")
                            grid(app.eta_oPlot,'minor')
                            xlabel(app.eta_oPlot,"$ \pi_c $","Interpreter","Latex");
                            ylabel(app.eta_oPlot,"$\eta_O$","Interpreter","Latex");

legend(app.eta_oPlot,'\pi_f='+string(pi_f),'Location','northwest','NumColumns',2);

                        case 'pi_f'
                            plot(app.FovermdotPlot,pi_f,F__mdot_0(:,:),"LineWidth",1.4)
                            title(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}
Graph$","Interpreter","Latex")
                            grid(app.FovermdotPlot,'minor')
                            xlabel(app.FovermdotPlot,"$\pi_f$","Interpreter","Latex");
                            ylabel(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
[lbf/(lbm/sec)]$","Interpreter","Latex");

legend(app.FovermdotPlot,'\pi_c='+string(pi_c),'Location','southeast','NumColumns',2);
```

```
                            plot(app.SPlot,pi_f,S(:,:),"LineWidth",1.4)
                            title(app.SPlot,"S $Graph$","Interpreter","Latex")
                            grid(app.SPlot,'minor')
                            xlabel(app.SPlot,"$\pi_f$","Interpreter","Latex");
                            ylabel(app.SPlot,"$S\ [(lbm/hr)/lbf]$","Interpreter","Latex");

legend(app.SPlot,'\pi_c='+string(pi_c),'Location','northeast','NumColumns',2);


plot(app.FuelPlot,pi_f,f(:,1),pi_f,f_AB(:,:),pi_f,f_DB(:,1),"LineWidth",1.4);
                            title(app.FuelPlot,"Fuel $Graph$","Interpreter","Latex")
                            grid(app.FuelPlot,'minor')
                            xlabel(app.FuelPlot,"$\pi_f$","Interpreter","Latex");
                            ylabel(app.FuelPlot,"$f,f_{AB},f_{DB}$","Interpreter","Latex");
                            leg = ['f for  \pi_c='+string(pi_c),'f_AB for 
\pi_c='+string(pi_c),'f_DB for \pi_c='+string(pi_c)];
                            legend(app.FuelPlot,leg,'Location','northwest','NumColumns',2);

                            plot(app.eta_cPlot,pi_f,eta_c(:,:),"LineWidth",1.4)
                            title(app.eta_cPlot,"$\eta_c$ $Graph$","Interpreter","Latex")
                            grid(app.eta_cPlot,'minor')
                            xlabel(app.eta_cPlot,"$\pi_f$","Interpreter","Latex");
                            ylabel(app.eta_cPlot,"$\eta_c$","Interpreter","Latex");

legend(app.eta_cPlot,'\pi_c='+string(pi_c),'Location','northeast','NumColumns',2);

                            plot(app.eta_tPlot,pi_f,eta_t(:,:),"LineWidth",1.4)
                            title(app.eta_tPlot,"$\eta_t$","Interpreter","Latex")
                            grid(app.eta_tPlot,'minor')
                            xlabel(app.eta_tPlot,"$\pi_f$","Interpreter","Latex");
                            ylabel(app.eta_tPlot,"$\eta_t Graph$","Interpreter","Latex");

legend(app.eta_tPlot,'\pi_c='+string(pi_c),'Location','northeast','NumColumns',2);

                            plot(app.eta_pPlot,pi_f,eta_P(:,:),"LineWidth",1.4);
                            title(app.eta_pPlot," Propulsive Efficiency 
$Graph$","Interpreter","Latex")
                            grid(app.eta_pPlot,'minor')
                            xlabel(app.eta_pPlot,"$ \pi_f $","Interpreter","Latex");
                            ylabel(app.eta_pPlot,"$\eta_P$","Interpreter","Latex");

legend(app.eta_pPlot,'\pi_c='+string(pi_c),'Location','northwest','NumColumns',2);

                            plot(app.eta_thermoPlot,pi_f,eta_T(:,:),"LineWidth",1.4);
                            title(app.eta_thermoPlot,"Thermal Efficiency 
$Graph$","Interpreter","Latex")
                            grid(app.eta_thermoPlot,'minor')
                            xlabel(app.eta_thermoPlot,"$ \pi_f $","Interpreter","Latex");
                            ylabel(app.eta_thermoPlot,"$\eta_T$","Interpreter","Latex");

legend(app.eta_thermoPlot,'\pi_c='+string(pi_c),'Location','northwest','NumColumns',2);

                            plot(app.eta_oPlot,pi_f,eta_O(:,:),"LineWidth",1.4);
                            title(app.eta_oPlot,"Efficiency $Graph$","Interpreter","Latex")
                            grid(app.eta_oPlot,'minor')
                            xlabel(app.eta_oPlot,"$ \pi_f $","Interpreter","Latex");
                            ylabel(app.eta_oPlot,"$\eta_O$","Interpreter","Latex");

legend(app.eta_oPlot,'\pi_c='+string(pi_c),'Location','northwest','NumColumns',2);
                    end

                case 'Varying Bypass and pi_c'
                    alpha = alpha_min:alpha_increment:alpha_max;
                    T_t4 = T_t4_min;
```

```
                    T_t7 = T_t7_min;
                    T_t17 = T_t17_min;
                    M_0 = M_0_min;
                    pi_f = pi_f_min;
                    pi_c = pi_c_min:pi_c_increment:pi_c_max;
                    tablo = zeros(length(alpha)*length(pi_c),18);

                    for i = 1:length(pi_c)
                        for j=1:length(alpha)

[F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,
j),eta_T(i,j),eta_O(i,j)] = ...

ATFwithSeperateExhausts(app,M_0,T_0,gamma_c,c_pc,gamma_t,c_pt,h_PR,...

gamma_AB,c_p_AB,gamma_DB,c_p_DB,pi_d_max,pi_b,pi_AB,pi_DB,pi_n,...

pi_fn,e_c,e_f,e_t,eta_b,eta_AB,eta_DB,eta_m,P_0__P_9,P_0__P_19,...
                                T_t4,T_t7,T_t17,pi_c(i),pi_f,alpha(j));

                            tablo(length(alpha)*(i-1)+j,:) = ...
                                [M_0,pi_c(i),pi_f,alpha(j),T_t4,T_t7,T_t17,...

F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,j
),eta_T(i,j),eta_O(i,j)];

                        end
                    end



                    % Creating Table
                    t =
table(tablo(:,1),tablo(:,2),tablo(:,3),tablo(:,4),tablo(:,5),tablo(:,6),tablo(:,7),...

tablo(:,8),tablo(:,9),tablo(:,10),tablo(:,11),tablo(:,12),tablo(:,13),tablo(:,14),...
                        tablo(:,15),tablo(:,16),tablo(:,17),tablo(:,18));
                    app.UITable.Data = t;
                    vars =
{'M_0','pi_c','pi_f','alpha','T_t4','T_t7','T_t17','F__mdot_0','f','f_AB','f_DB','S','eta_c
','eta_t','eta_f','eta_P','eta_T','eta_O'};
                    app.UITable.ColumnName = vars;

                    switch xaxisval


                        case 'pi_c'
                            % Handling Plots

                            plot(app.FovermdotPlot,pi_c,F__mdot_0(:,:),"LineWidth",1.4)
                            title(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
Graph$","Interpreter","Latex")
                            grid(app.FovermdotPlot,'minor')
                            xlabel(app.FovermdotPlot,"$\pi_c$","Interpreter","Latex");
                            ylabel(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
[lbf/(lbm/sec)]$","Interpreter","Latex");

legend(app.FovermdotPlot,'\alpha='+string(alpha),'Location','southeast','NumColumns',2);

                            plot(app.SPlot,pi_c,S(:,:),"LineWidth",1.4)
                            title(app.SPlot,"S $Graph$","Interpreter","Latex")
                            grid(app.SPlot,'minor')
                            xlabel(app.SPlot,"$\pi_c$","Interpreter","Latex");
                            ylabel(app.SPlot,"$S\ [(lbm/hr)/lbf]$","Interpreter","Latex");
```

```
legend(app.SPlot,'\alpha='+string(alpha),'Location','northeast','NumColumns',2);

                            p =
plot(app.FuelPlot,pi_c,f(:,:),pi_c,f_AB(:,:),pi_c,f_DB(:,:),"LineWidth",1.4);
                            title(app.FuelPlot,"Fuel $Graph$","Interpreter","Latex")
                            grid(app.FuelPlot,'minor')
                            xlabel(app.FuelPlot,"$\pi_c$","Interpreter","Latex");
                            ylabel(app.FuelPlot,"$f,f_{AB},f_{DB}$","Interpreter","Latex");
                            leg = ['f for \alpha='+string(alpha),'f_{AB} for
\alpha='+string(alpha),'f_{DB} for \alpha='+string(alpha)];
                            legend(app.FuelPlot,leg,'Location','northwest','NumColumns',2);

                            plot(app.eta_cPlot,pi_c,eta_c(:,:),"LineWidth",1.4)
                            title(app.eta_cPlot,"$\eta_c$ $Graph$","Interpreter","Latex")
                            grid(app.eta_cPlot,'minor')
                            xlabel(app.eta_cPlot,"$\pi_c$","Interpreter","Latex");
                            ylabel(app.eta_cPlot,"$\eta_c$","Interpreter","Latex");

legend(app.eta_cPlot,'\alpha='+string(alpha),'Location','northeast','NumColumns',2);

                            plot(app.eta_tPlot,pi_c,eta_t(:,:),"LineWidth",1.4)
                            title(app.eta_tPlot,"$\eta_t$","Interpreter","Latex")
                            grid(app.eta_tPlot,'minor')
                            xlabel(app.eta_tPlot,"$\pi_c$","Interpreter","Latex");
                            ylabel(app.eta_tPlot,"$\eta_t Graph$","Interpreter","Latex");

legend(app.eta_tPlot,'\alpha='+string(alpha),'Location','northeast','NumColumns',2);

                            plot(app.eta_pPlot,pi_c,eta_P(:,:),"LineWidth",1.4);
                            title(app.eta_pPlot," Propulsive Efficiency
$Graph$","Interpreter","Latex")
                            grid(app.eta_pPlot,'minor')
                            xlabel(app.eta_pPlot,"$ \pi_c $","Interpreter","Latex");
                            ylabel(app.eta_pPlot,"$\eta_P$","Interpreter","Latex");

legend(app.eta_pPlot,'\alpha='+string(alpha),'Location','northwest','NumColumns',2);

                            plot(app.eta_thermoPlot,pi_c,eta_T(:,:),"LineWidth",1.4);
                            title(app.eta_thermoPlot,"Thermal Efficiency
$Graph$","Interpreter","Latex")
                            grid(app.eta_thermoPlot,'minor')
                            xlabel(app.eta_thermoPlot,"$ \pi_c $","Interpreter","Latex");
                            ylabel(app.eta_thermoPlot,"$\eta_T$","Interpreter","Latex");

legend(app.eta_thermoPlot,'\alpha='+string(alpha),'Location','northwest','NumColumns',2);

                            plot(app.eta_oPlot,pi_c,eta_O(:,:),"LineWidth",1.4);
                            title(app.eta_oPlot,"Efficiency $Graph$","Interpreter","Latex")
                            grid(app.eta_oPlot,'minor')
                            xlabel(app.eta_oPlot,"$ \pi_c $","Interpreter","Latex");
                            ylabel(app.eta_oPlot,"$\eta_O$","Interpreter","Latex");

legend(app.eta_oPlot,'\alpha='+string(alpha),'Location','northwest','NumColumns',2);

                        case 'alpha'
                            plot(app.FovermdotPlot,alpha,F__mdot_0(:,:),"LineWidth",1.4)
                            title(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}
Graph$","Interpreter","Latex")
                            grid(app.FovermdotPlot,'minor')
                            xlabel(app.FovermdotPlot,"$\alpha$","Interpreter","Latex");
                            ylabel(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
[lbf/(lbm/sec)]$","Interpreter","Latex");

legend(app.FovermdotPlot,'\pi_c='+string(pi_c),'Location','southeast','NumColumns',2);
```

```
                            plot(app.SPlot,alpha,S(:,:),"LineWidth",1.4)
                            title(app.SPlot,"S $Graph$","Interpreter","Latex")
                            grid(app.SPlot,'minor')
                            xlabel(app.SPlot,"$\alpha$","Interpreter","Latex");
                            ylabel(app.SPlot,"$S\ [(lbm/hr)/lbf]$","Interpreter","Latex");

legend(app.SPlot,'\pi_c='+string(pi_c),'Location','northeast','NumColumns',2);


plot(app.FuelPlot,alpha,f(:,:),alpha,f_AB(:,:),alpha,f_DB(:,:),"LineWidth",1.4);
                            title(app.FuelPlot,"Fuel $Graph$","Interpreter","Latex")
                            grid(app.FuelPlot,'minor')
                            xlabel(app.FuelPlot,"$\alpha$","Interpreter","Latex");
                            ylabel(app.FuelPlot,"$f,f_{AB},f_{DB}$","Interpreter","Latex");
                            leg = ['f for \pi_c='+string(pi_c),'f_AB for
\pi_c='+string(pi_c),'f_DB for \pi_c='+string(pi_c)];
                            legend(app.FuelPlot,leg,'Location','northwest','NumColumns',2);

                            plot(app.eta_cPlot,alpha,eta_c(:,:),"LineWidth",1.4)
                            title(app.eta_cPlot,"$\eta_c$ $Graph$","Interpreter","Latex")
                            grid(app.eta_cPlot,'minor')
                            xlabel(app.eta_cPlot,"$\alpha$","Interpreter","Latex");
                            ylabel(app.eta_cPlot,"$\eta_c$","Interpreter","Latex");

legend(app.eta_cPlot,'\pi_c='+string(pi_c),'Location','northeast','NumColumns',2);

                            plot(app.eta_tPlot,alpha,eta_t(:,:),"LineWidth",1.4)
                            title(app.eta_tPlot,"$\eta_t$","Interpreter","Latex")
                            grid(app.eta_tPlot,'minor')
                            xlabel(app.eta_tPlot,"$\alpha$","Interpreter","Latex");
                            ylabel(app.eta_tPlot,"$\eta_t Graph$","Interpreter","Latex");

legend(app.eta_tPlot,'\pi_c='+string(pi_c),'Location','northeast','NumColumns',2);

                            plot(app.eta_pPlot,alpha,eta_P(:,:),"LineWidth",1.4);
                            title(app.eta_pPlot," Propulsive Efficiency
$Graph$","Interpreter","Latex")
                            grid(app.eta_pPlot,'minor')
                            xlabel(app.eta_pPlot,"$ \alpha $","Interpreter","Latex");
                            ylabel(app.eta_pPlot,"$\eta_P$","Interpreter","Latex");

legend(app.eta_pPlot,'\pi_c='+string(pi_c),'Location','northwest','NumColumns',2);

                            plot(app.eta_thermoPlot,alpha,eta_T(:,:),"LineWidth",1.4);
                            title(app.eta_thermoPlot,"Thermal Efficiency
$Graph$","Interpreter","Latex")
                            grid(app.eta_thermoPlot,'minor')
                            xlabel(app.eta_thermoPlot,"$ \alpha $","Interpreter","Latex");
                            ylabel(app.eta_thermoPlot,"$\eta_T$","Interpreter","Latex");

legend(app.eta_thermoPlot,'\pi_c='+string(pi_c),'Location','northwest','NumColumns',2);

                            plot(app.eta_oPlot,alpha,eta_O(:,:),"LineWidth",1.4);
                            title(app.eta_oPlot,"Efficiency $Graph$","Interpreter","Latex")
                            grid(app.eta_oPlot,'minor')
                            xlabel(app.eta_oPlot,"$ \alpha $","Interpreter","Latex");
                            ylabel(app.eta_oPlot,"$\eta_O$","Interpreter","Latex");

legend(app.eta_oPlot,'\pi_c='+string(pi_c),'Location','northwest','NumColumns',2);
                    end

                case 'Varying Mach No and pi_c'
                    alpha = alpha_min;
                    T_t4 = T_t4_min;
```

```
                    T_t7 = T_t7_min;
                    T_t17 = T_t17_min;
                    M_0 = M_0_min:M_0_increment:M_0_max;
                    pi_f = pi_f_min;
                    pi_c = pi_c_min:pi_c_increment:pi_c_max;
                    tablo = zeros(length(M_0)*length(pi_c),18);

                    for i = 1:length(M_0)
                        for j=1:length(pi_c)

[F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,
j),eta_T(i,j),eta_O(i,j)] = ...

ATFwithSeperateExhausts(app,M_0(i),T_0,gamma_c,c_pc,gamma_t,c_pt,h_PR,...

gamma_AB,c_p_AB,gamma_DB,c_p_DB,pi_d_max,pi_b,pi_AB,pi_DB,pi_n,...

pi_fn,e_c,e_f,e_t,eta_b,eta_AB,eta_DB,eta_m,P_0__P_9,P_0__P_19,...
                                T_t4,T_t7,T_t17,pi_c(j),pi_f,alpha);

                            tablo(length(pi_c)*(i-1)+j,:) = ...
                                [M_0(i),pi_c(j),pi_f,alpha,T_t4,T_t7,T_t17,...

F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,j
),eta_T(i,j),eta_O(i,j)];

                        end
                    end


                    % Creating Table
                    t =
table(tablo(:,1),tablo(:,2),tablo(:,3),tablo(:,4),tablo(:,5),tablo(:,6),tablo(:,7),...

tablo(:,8),tablo(:,9),tablo(:,10),tablo(:,11),tablo(:,12),tablo(:,13),tablo(:,14),...
                        tablo(:,15),tablo(:,16),tablo(:,17),tablo(:,18));
                    app.UITable.Data = t;
                    vars =
{'M_0','pi_c','pi_f','alpha','T_t4','T_t7','T_t17','F__mdot_0','f','f_AB','f_DB','S','eta_c
','eta_t','eta_f','eta_P','eta_T','eta_O'};
                    app.UITable.ColumnName = vars;

                    % Handling Plots
                    plot(app.FovermdotPlot,M_0,F__mdot_0(:,:),"LineWidth",1.4)
                    title(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
Graph$","Interpreter","Latex")
                    grid(app.FovermdotPlot,'minor')
                    xlabel(app.FovermdotPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
[lbf/(lbm/sec)]$","Interpreter","Latex");

legend(app.FovermdotPlot,'\pi_c='+string(pi_c),'Location','southeast','NumColumns',2);

                    plot(app.SPlot,M_0,S(:,:),"LineWidth",1.4)
                    title(app.SPlot,"S $Graph$","Interpreter","Latex")
                    grid(app.SPlot,'minor')
                    xlabel(app.SPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.SPlot,"$S\ [(lbm/hr)/lbf]$","Interpreter","Latex");

legend(app.SPlot,'\pi_c='+string(pi_c),'Location','northeast','NumColumns',2);


plot(app.FuelPlot,M_0,f(:,:),M_0,f_AB(:,:),M_0,f_DB(:,:),"LineWidth",1.4);
                    title(app.FuelPlot,"Fuel $Graph$","Interpreter","Latex")
                    grid(app.FuelPlot,'minor')
```

```
                    xlabel(app.FuelPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.FuelPlot,"$f,f_{AB},f_{DB}$","Interpreter","Latex");
                    leg = ['f for \pi_c='+string(pi_c),'f_{AB} for
\pi_c='+string(pi_c),'f_{DB} for \pi_c='+string(pi_c)];
                    legend(app.FuelPlot,leg,'Location','northwest','NumColumns',2);

                    plot(app.eta_cPlot,M_0,eta_c(:,:),"LineWidth",1.4)
                    title(app.eta_cPlot,"$\eta_c$ $Graph$","Interpreter","Latex")
                    grid(app.eta_cPlot,'minor')
                    xlabel(app.eta_cPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.eta_cPlot,"$\eta_c$","Interpreter","Latex");

legend(app.eta_cPlot,'\pi_c='+string(pi_c),'Location','northeast','NumColumns',2);

                    plot(app.eta_tPlot,M_0,eta_t(:,:),"LineWidth",1.4)
                    title(app.eta_tPlot,"$\eta_t$","Interpreter","Latex")
                    grid(app.eta_tPlot,'minor')
                    xlabel(app.eta_tPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.eta_tPlot,"$\eta_t Graph$","Interpreter","Latex");

legend(app.eta_tPlot,'\pi_c='+string(pi_c),'Location','northeast','NumColumns',2);

                    plot(app.eta_pPlot,M_0,eta_P(:,:),"LineWidth",1.4);
                    title(app.eta_pPlot," Propulsive Efficiency
$Graph$","Interpreter","Latex")
                    grid(app.eta_pPlot,'minor')
                    xlabel(app.eta_pPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_pPlot,"$\eta_P$","Interpreter","Latex");

legend(app.eta_pPlot,'\pi_c='+string(pi_c),'Location','northwest','NumColumns',2);

                    plot(app.eta_thermoPlot,M_0,eta_T(:,:),"LineWidth",1.4);
                    title(app.eta_thermoPlot,"Thermal Efficiency
$Graph$","Interpreter","Latex")
                    grid(app.eta_thermoPlot,'minor')
                    xlabel(app.eta_thermoPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_thermoPlot,"$\eta_T$","Interpreter","Latex");

legend(app.eta_thermoPlot,'\pi_c='+string(pi_c),'Location','northwest','NumColumns',2);

                    plot(app.eta_oPlot,M_0,eta_O(:,:),"LineWidth",1.4);
                    title(app.eta_oPlot,"Efficiency $Graph$","Interpreter","Latex")
                    grid(app.eta_oPlot,'minor')
                    xlabel(app.eta_oPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_oPlot,"$\eta_O$","Interpreter","Latex");

legend(app.eta_oPlot,'\pi_c='+string(pi_c),'Location','northwest','NumColumns',2);

                case 'Varying Mach No and Bypass'
                    alpha = alpha_min:alpha_increment:alpha_max;
                    M_0 = M_0_min:M_0_increment:M_0_max;
                    pi_f = pi_f_min;
                    pi_c = pi_c_min;
                    T_t4 = T_t4_min;
                    T_t7 = T_t7_min;
                    T_t17 = T_t17_min;
                    tablo = zeros(length(M_0)*length(alpha),18);

                    for i = 1:length(M_0)
                        for j=1:length(alpha)

[F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,
j),eta_T(i,j),eta_O(i,j)] = ...

ATFwithSeperateExhausts(app,M_0(i),T_0,gamma_c,c_pc,gamma_t,c_pt,h_PR,...
```

```
gamma_AB,c_p_AB,gamma_DB,c_p_DB,pi_d_max,pi_b,pi_AB,pi_DB,pi_n,...

pi_fn,e_c,e_f,e_t,eta_b,eta_AB,eta_DB,eta_m,P_0__P_9,P_0__P_19,...
                                T_t4,T_t7,T_t17,pi_c,pi_f,alpha(j));

                            tablo(length(alpha)*(i-1)+j,:) = ...
                                [M_0(i),pi_c,pi_f,alpha(j),T_t4,T_t7,T_t17,...

F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,j
),eta_T(i,j),eta_O(i,j)];

                        end
                    end


                    % Creating Table
                    t =
table(tablo(:,1),tablo(:,2),tablo(:,3),tablo(:,4),tablo(:,5),tablo(:,6),tablo(:,7),...

tablo(:,8),tablo(:,9),tablo(:,10),tablo(:,11),tablo(:,12),tablo(:,13),tablo(:,14),...
                        tablo(:,15),tablo(:,16),tablo(:,17),tablo(:,18));
                    app.UITable.Data = t;
                    vars =
{'M_0','pi_c','pi_f','alpha','T_t4','T_t7','T_t17','F__mdot_0','f','f_AB','f_DB','S','eta_c
','eta_t','eta_f','eta_P','eta_T','eta_O'};
                    app.UITable.ColumnName = vars;

                    % Handling Plots
                    plot(app.FovermdotPlot,M_0,F__mdot_0(:,:),"LineWidth",1.4)
                    title(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
Graph$","Interpreter","Latex")
                    grid(app.FovermdotPlot,'minor')
                    xlabel(app.FovermdotPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
[lbf/(lbm/sec)]$","Interpreter","Latex");

legend(app.FovermdotPlot,'\alpha='+string(alpha),'Location','northeast','NumColumns',2);

                    plot(app.SPlot,M_0,S(:,:),"LineWidth",1.4)
                    title(app.SPlot,"S $Graph$","Interpreter","Latex")
                    grid(app.SPlot,'minor')
                    xlabel(app.SPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.SPlot,"$S\ [(lbm/hr)/lbf]$","Interpreter","Latex");

legend(app.SPlot,'\alpha='+string(alpha),'Location','northeast','NumColumns',2);


plot(app.FuelPlot,M_0,f(:,1),M_0,f_AB(:,:),M_0,f_DB(:,1),"LineWidth",1.4);
                    title(app.FuelPlot,"Fuel $Graph$","Interpreter","Latex")
                    grid(app.FuelPlot,'minor')
                    xlabel(app.FuelPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.FuelPlot,"$f,f_{AB},f_{DB}$","Interpreter","Latex");
                    leg = ['f for all \alpha=','f_{AB} for \alpha='+string(alpha),'f_{DB}
for all \alpha='];
                    legend(app.FuelPlot,leg,'Location','northwest','NumColumns',2);

                    plot(app.eta_cPlot,M_0,eta_c(:,:),"LineWidth",1.4)
                    title(app.eta_cPlot,"$\eta_c$ $Graph$","Interpreter","Latex")
                    grid(app.eta_cPlot,'minor')
                    xlabel(app.eta_cPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.eta_cPlot,"$\eta_c$","Interpreter","Latex");

legend(app.eta_cPlot,'\alpha='+string(alpha),'Location','northeast','NumColumns',2);
```

```
                    plot(app.eta_tPlot,M_0,eta_t(:,:),"LineWidth",1.4)
                    title(app.eta_tPlot,"$\eta_t$","Interpreter","Latex")
                    grid(app.eta_tPlot,'minor')
                    xlabel(app.eta_tPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.eta_tPlot,"$\eta_t Graph$","Interpreter","Latex");

legend(app.eta_tPlot,'\alpha='+string(alpha),'Location','northeast','NumColumns',2);

                    plot(app.eta_pPlot,M_0,eta_P(:,:),"LineWidth",1.4);
                    title(app.eta_pPlot," Propulsive Efficiency
$Graph$","Interpreter","Latex")
                    grid(app.eta_pPlot,'minor')
                    xlabel(app.eta_pPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_pPlot,"$\eta_P$","Interpreter","Latex");

legend(app.eta_pPlot,'\alpha='+string(alpha),'Location','northwest','NumColumns',2);

                    plot(app.eta_thermoPlot,M_0,eta_T(:,:),"LineWidth",1.4);
                    title(app.eta_thermoPlot,"Thermal Efficiency
$Graph$","Interpreter","Latex")
                    grid(app.eta_thermoPlot,'minor')
                    xlabel(app.eta_thermoPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_thermoPlot,"$\eta_T$","Interpreter","Latex");

legend(app.eta_thermoPlot,'\alpha='+string(alpha),'Location','northwest','NumColumns',2);

                    plot(app.eta_oPlot,M_0,eta_O(:,:),"LineWidth",1.4);
                    title(app.eta_oPlot,"Efficiency $Graph$","Interpreter","Latex")
                    grid(app.eta_oPlot,'minor')
                    xlabel(app.eta_oPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_oPlot,"$\eta_O$","Interpreter","Latex");

legend(app.eta_oPlot,'\alpha='+string(alpha),'Location','northwest','NumColumns',2);

                case 'Varying Mach No and pi_f'
                    alpha = alpha_min;
                    M_0 = M_0_min:M_0_increment:M_0_max;
                    pi_f = pi_f_min:pi_f_increment:pi_f_max;
                    pi_c = pi_c_min;
                    T_t4 = T_t4_min;
                    T_t7 = T_t7_min;
                    T_t17 = T_t17_min;
                    tablo = zeros(length(pi_f)*length(M_0),18);

                    for i = 1:length(M_0)
                        for j=1:length(pi_f)

[F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,
j),eta_T(i,j),eta_O(i,j)] = ...

ATFwithSeperateExhausts(app,M_0(i),T_0,gamma_c,c_pc,gamma_t,c_pt,h_PR,...

gamma_AB,c_p_AB,gamma_DB,c_p_DB,pi_d_max,pi_b,pi_AB,pi_DB,pi_n,...

pi_fn,e_c,e_f,e_t,eta_b,eta_AB,eta_DB,eta_m,P_0__P_9,P_0__P_19,...
                                T_t4,T_t7,T_t17,pi_c,pi_f(j),alpha);

                            tablo(length(pi_f)*(i-1)+j,:) = ...
                                [M_0(i),pi_c,pi_f(j),alpha,T_t4,T_t7,T_t17,...

F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,j
),eta_T(i,j),eta_O(i,j)];

                        end
                    end
```

```
                    % Creating Table
                    t =
table(tablo(:,1),tablo(:,2),tablo(:,3),tablo(:,4),tablo(:,5),tablo(:,6),tablo(:,7),...

tablo(:,8),tablo(:,9),tablo(:,10),tablo(:,11),tablo(:,12),tablo(:,13),tablo(:,14),...
                        tablo(:,15),tablo(:,16),tablo(:,17),tablo(:,18));
                    app.UITable.Data = t;
                    vars =
{'M_0','pi_c','pi_f','alpha','T_t4','T_t7','T_t17','F__mdot_0','f','f_AB','f_DB','S','eta_c
','eta_t','eta_f','eta_P','eta_T','eta_O'};
                    app.UITable.ColumnName = vars;

                    % Handling Plots
                    plot(app.FovermdotPlot,M_0,F__mdot_0(:,:),"LineWidth",1.4);
                    %                       hold(app.FovermdotPlot,'on');
                    %
plot(app.FovermdotPlot,S(:,:)',F__mdot_0(:,:)',"Marker",'o',"LineWidth",1.4); % degisiklik
yapilacak
                    title(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
Graph$","Interpreter","Latex")
                    grid(app.FovermdotPlot,'minor')
                    xlabel(app.FovermdotPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
[lbf/(lbm/sec)]$","Interpreter","Latex");

legend(app.FovermdotPlot,'\pi_f='+string(pi_f),'Location','northeast','NumColumns',2);

                    plot(app.SPlot,M_0,S(:,:),"LineWidth",1.4)
                    title(app.SPlot,"S $Graph$","Interpreter","Latex")
                    grid(app.SPlot,'minor')
                    xlabel(app.SPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.SPlot,"$S\ [(lbm/hr)/lbf]$","Interpreter","Latex");

legend(app.SPlot,'\pi_f='+string(pi_f),'Location','northeast','NumColumns',2);


plot(app.FuelPlot,M_0,f(:,1),M_0,f_AB(:,:),M_0,f_DB(:,:),"LineWidth",1.4);%%
                    title(app.FuelPlot,"Fuel $Graph$","Interpreter","Latex")
                    grid(app.FuelPlot,'minor')
                    xlabel(app.FuelPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.FuelPlot,"$f,f_{AB},f_{DB}$","Interpreter","Latex");
                    leg = ['f for all \pi_f','f_{AB} for \pi_f='+string(pi_f),'f_{DB} for
\pi_f='+string(pi_f)];
                    legend(app.FuelPlot,leg,'Location','northwest','NumColumns',2);

                    plot(app.eta_cPlot,M_0,eta_c(:,:),"LineWidth",1.4)
                    title(app.eta_cPlot,"$\eta_c$ $Graph$","Interpreter","Latex")
                    grid(app.eta_cPlot,'minor')
                    xlabel(app.eta_cPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.eta_cPlot,"$\eta_c$","Interpreter","Latex");

legend(app.eta_cPlot,'\pi_f='+string(pi_f),'Location','northeast','NumColumns',2);

                    plot(app.eta_tPlot,M_0,eta_t(:,:),"LineWidth",1.4)
                    title(app.eta_tPlot,"$\eta_t$","Interpreter","Latex")
                    grid(app.eta_tPlot,'minor')
                    xlabel(app.eta_tPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.eta_tPlot,"$\eta_t Graph$","Interpreter","Latex");

legend(app.eta_tPlot,'\pi_f='+string(pi_f),'Location','northeast','NumColumns',2);

                    plot(app.eta_pPlot,M_0,eta_P(:,:),"LineWidth",1.4);
```

```
                    title(app.eta_pPlot," Propulsive Efficiency
$Graph$","Interpreter","Latex")
                    grid(app.eta_pPlot,'minor')
                    xlabel(app.eta_pPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_pPlot,"$\eta_P$","Interpreter","Latex");

legend(app.eta_pPlot,'\pi_f='+string(pi_f),'Location','northwest','NumColumns',2);

                    plot(app.eta_thermoPlot,M_0,eta_T(:,:),"LineWidth",1.4);
                    title(app.eta_thermoPlot,"Thermal Efficiency
$Graph$","Interpreter","Latex")
                    grid(app.eta_thermoPlot,'minor')
                    xlabel(app.eta_thermoPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_thermoPlot,"$\eta_T$","Interpreter","Latex");

legend(app.eta_thermoPlot,'\pi_f='+string(pi_f),'Location','northwest','NumColumns',2);

                    plot(app.eta_oPlot,M_0,eta_O(:,:),"LineWidth",1.4);
                    title(app.eta_oPlot,"Efficiency $Graph$","Interpreter","Latex")
                    grid(app.eta_oPlot,'minor')
                    xlabel(app.eta_oPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_oPlot,"$\eta_O$","Interpreter","Latex");

legend(app.eta_oPlot,'\pi_f='+string(pi_f),'Location','northwest','NumColumns',2);

                case 'Varying Mach No and T_t4'
                    alpha = alpha_min;
                    M_0 = M_0_min:M_0_increment:M_0_max;
                    pi_f = pi_f_min;
                    pi_c = pi_c_min;
                    T_t4 = T_t4_min:T_t4_increment:T_t4_max;
                    T_t7 = T_t7_min;
                    T_t17 = T_t17_min;
                    tablo = zeros(length(M_0)*length(T_t4),18);

                    for i = 1:length(M_0)
                        for j=1:length(T_t4)

[F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,
j),eta_T(i,j),eta_O(i,j)] = ...

ATFwithSeperateExhausts(app,M_0(i),T_0,gamma_c,c_pc,gamma_t,c_pt,h_PR,...

gamma_AB,c_p_AB,gamma_DB,c_p_DB,pi_d_max,pi_b,pi_AB,pi_DB,pi_n,...

pi_fn,e_c,e_f,e_t,eta_b,eta_AB,eta_DB,eta_m,P_0__P_9,P_0__P_19,...
                                T_t4(j),T_t7,T_t17,pi_c,pi_f,alpha);

                            tablo(length(T_t4)*(i-1)+j,:) = ...
                                [M_0(i),pi_c,pi_f,alpha,T_t4(j),T_t7,T_t17,...

F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,j
),eta_T(i,j),eta_O(i,j)];

                        end
                    end


                    % Creating Table
                    t =
table(tablo(:,1),tablo(:,2),tablo(:,3),tablo(:,4),tablo(:,5),tablo(:,6),tablo(:,7),...

tablo(:,8),tablo(:,9),tablo(:,10),tablo(:,11),tablo(:,12),tablo(:,13),tablo(:,14),...
                        tablo(:,15),tablo(:,16),tablo(:,17),tablo(:,18));
                    app.UITable.Data = t;
```

```
                    vars =
{'M_0','pi_c','pi_f','alpha','T_t4','T_t7','T_t17','F__mdot_0','f','f_AB','f_DB','S','eta_c
','eta_t','eta_f','eta_P','eta_T','eta_O'};
                    app.UITable.ColumnName = vars;

                    % Handling Plots
                    plot(app.FovermdotPlot,M_0,F__mdot_0(:,:),"LineWidth",1.4);
                    title(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
Graph$","Interpreter","Latex")
                    grid(app.FovermdotPlot,'minor')
                    xlabel(app.FovermdotPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
[lbf/(lbm/sec)]$","Interpreter","Latex");

legend(app.FovermdotPlot,'T_{t4}='+string(T_t4),'Location','northeast','NumColumns',2);

                    plot(app.SPlot,M_0,S(:,:),"LineWidth",1.4)
                    title(app.SPlot,"S $Graph$","Interpreter","Latex")
                    grid(app.SPlot,'minor')
                    xlabel(app.SPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.SPlot,"$S\ [(lbm/hr)/lbf]$","Interpreter","Latex");

legend(app.SPlot,'T_{t4}='+string(T_t4),'Location','northeast','NumColumns',2);


plot(app.FuelPlot,M_0,f(:,:),M_0,f_AB(:,:),M_0,f_DB(:,:),"LineWidth",1.4);%%
                    title(app.FuelPlot,"Fuel $Graph$","Interpreter","Latex")
                    grid(app.FuelPlot,'minor')
                    xlabel(app.FuelPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.FuelPlot,"$f,f_{AB},f_{DB}$","Interpreter","Latex");
                    leg = ['f for all T_{t4}'+string(T_t4),'f_{AB} for
T_{t4}='+string(T_t4),'f_{DB} for T_{t4}='+string(T_t4)];
                    legend(app.FuelPlot,leg,'Location','northwest','NumColumns',2);

                    plot(app.eta_cPlot,M_0,eta_c(:,:),"LineWidth",1.4)
                    title(app.eta_cPlot,"$\eta_c$ $Graph$","Interpreter","Latex")
                    grid(app.eta_cPlot,'minor')
                    xlabel(app.eta_cPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.eta_cPlot,"$\eta_c$","Interpreter","Latex");

legend(app.eta_cPlot,'T_{t4}='+string(T_t4),'Location','northeast','NumColumns',2);

                    plot(app.eta_tPlot,M_0,eta_t(:,:),"LineWidth",1.4)
                    title(app.eta_tPlot,"$\eta_t$","Interpreter","Latex")
                    grid(app.eta_tPlot,'minor')
                    xlabel(app.eta_tPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.eta_tPlot,"$\eta_t Graph$","Interpreter","Latex");

legend(app.eta_tPlot,'T_{t4}='+string(T_t4),'Location','northeast','NumColumns',2);


                    plot(app.eta_pPlot,M_0,eta_P(:,:),"LineWidth",1.4);
                    title(app.eta_pPlot," Propulsive Efficiency
$Graph$","Interpreter","Latex")
                    grid(app.eta_pPlot,'minor')
                    xlabel(app.eta_pPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_pPlot,"$\eta_P$","Interpreter","Latex");

legend(app.eta_pPlot,'T_{t4}='+string(T_t4),'Location','northwest','NumColumns',2);

                    plot(app.eta_thermoPlot,M_0,eta_T(:,:),"LineWidth",1.4);
                    title(app.eta_thermoPlot,"Thermal Efficiency
$Graph$","Interpreter","Latex")
                    grid(app.eta_thermoPlot,'minor')
                    xlabel(app.eta_thermoPlot,"$ M_0 $","Interpreter","Latex");
```

```
                    ylabel(app.eta_thermoPlot,"$\eta_T$","Interpreter","Latex");

legend(app.eta_thermoPlot,'T_{t4}='+string(T_t4),'Location','northwest','NumColumns',2);

                    plot(app.eta_oPlot,M_0,eta_O(:,:),"LineWidth",1.4);
                    title(app.eta_oPlot,"Efficiency $Graph$","Interpreter","Latex")
                    grid(app.eta_oPlot,'minor')
                    xlabel(app.eta_oPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_oPlot,"$\eta_O$","Interpreter","Latex");

legend(app.eta_oPlot,'T_{t4}='+string(T_t4),'Location','northwest','NumColumns',2);

                case 'Varying Mach No and T_t7'
                    alpha = alpha_min;
                    M_0 = M_0_min:M_0_increment:M_0_max;
                    pi_f = pi_f_min;
                    pi_c = pi_c_min;
                    T_t4 = T_t4_min;
                    T_t7 = T_t7_min:T_t7_increment:T_t7_max;
                    T_t17 = T_t17_min;
                    tablo = zeros(length(M_0)*length(T_t7),18);

                    for i = 1:length(M_0)
                        for j=1:length(T_t7)

[F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,
j),eta_T(i,j),eta_O(i,j)] = ...

ATFwithSeperateExhausts(app,M_0(i),T_0,gamma_c,c_pc,gamma_t,c_pt,h_PR,...

gamma_AB,c_p_AB,gamma_DB,c_p_DB,pi_d_max,pi_b,pi_AB,pi_DB,pi_n,...

pi_fn,e_c,e_f,e_t,eta_b,eta_AB,eta_DB,eta_m,P_0__P_9,P_0__P_19,...
                                T_t4,T_t7(j),T_t17,pi_c,pi_f,alpha);

                            tablo(length(T_t7)*(i-1)+j,:) = ...
                                [M_0(i),pi_c,pi_f,alpha,T_t4,T_t7(j),T_t17,...

F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,j
),eta_T(i,j),eta_O(i,j)];

                        end
                    end


                    % Creating Table
                    t =
table(tablo(:,1),tablo(:,2),tablo(:,3),tablo(:,4),tablo(:,5),tablo(:,6),tablo(:,7),...

tablo(:,8),tablo(:,9),tablo(:,10),tablo(:,11),tablo(:,12),tablo(:,13),tablo(:,14),...
                        tablo(:,15),tablo(:,16),tablo(:,17),tablo(:,18));
                    app.UITable.Data = t;
                    vars =
{'M_0','pi_c','pi_f','alpha','T_t4','T_t7','T_t17','F__mdot_0','f','f_AB','f_DB','S','eta_c
','eta_t','eta_f','eta_P','eta_T','eta_O'};
                    app.UITable.ColumnName = vars;

                    % Handling Plots
                    plot(app.FovermdotPlot,M_0,F__mdot_0(:,:),"LineWidth",1.4);
                    title(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
Graph$","Interpreter","Latex")
                    grid(app.FovermdotPlot,'minor')
                    xlabel(app.FovermdotPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
[lbf/(lbm/sec)]$","Interpreter","Latex");
```

```
legend(app.FovermdotPlot,'T_{t7}='+string(T_t7),'Location','northeast','NumColumns',2);

                    plot(app.SPlot,M_0,S(:,:),"LineWidth",1.4)
                    title(app.SPlot,"S $Graph$","Interpreter","Latex")
                    grid(app.SPlot,'minor')
                    xlabel(app.SPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.SPlot,"$S\ [(lbm/hr)/lbf]$","Interpreter","Latex");

legend(app.SPlot,'T_{t7}='+string(T_t7),'Location','northeast','NumColumns',2);


plot(app.FuelPlot,M_0,f(:,:),M_0,f_AB(:,:),M_0,f_DB(:,:),"LineWidth",1.4);%%
                    title(app.FuelPlot,"Fuel $Graph$","Interpreter","Latex")
                    grid(app.FuelPlot,'minor')
                    xlabel(app.FuelPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.FuelPlot,"$f,f_{AB},f_{DB}$","Interpreter","Latex");
                    leg = ['f for all T_{t7}'+string(T_t7),'f_{AB} for
T_{t7}='+string(T_t7),'f_{DB} for T_{t7}='+string(T_t7)];
                    legend(app.FuelPlot,leg,'Location','northwest','NumColumns',2);

                    plot(app.eta_cPlot,M_0,eta_c(:,:),"LineWidth",1.4)
                    title(app.eta_cPlot,"$\eta_c$ $Graph$","Interpreter","Latex")
                    grid(app.eta_cPlot,'minor')
                    xlabel(app.eta_cPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.eta_cPlot,"$\eta_c$","Interpreter","Latex");

legend(app.eta_cPlot,'T_{t7}='+string(T_t7),'Location','northeast','NumColumns',2);

                    plot(app.eta_tPlot,M_0,eta_t(:,:),"LineWidth",1.4)
                    title(app.eta_tPlot,"$\eta_t$","Interpreter","Latex")
                    grid(app.eta_tPlot,'minor')
                    xlabel(app.eta_tPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.eta_tPlot,"$\eta_t Graph$","Interpreter","Latex");

legend(app.eta_tPlot,'T_{t7}='+string(T_t7),'Location','northeast','NumColumns',2);

                    plot(app.eta_pPlot,M_0,eta_P(:,:),"LineWidth",1.4);
                    title(app.eta_pPlot," Propulsive Efficiency
$Graph$","Interpreter","Latex")
                    grid(app.eta_pPlot,'minor')
                    xlabel(app.eta_pPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_pPlot,"$\eta_P$","Interpreter","Latex");

legend(app.eta_pPlot,'T_{t7}='+string(T_t7),'Location','northwest','NumColumns',2);

                    plot(app.eta_thermoPlot,M_0,eta_T(:,:),"LineWidth",1.4);
                    title(app.eta_thermoPlot,"Thermal Efficiency
$Graph$","Interpreter","Latex")
                    grid(app.eta_thermoPlot,'minor')
                    xlabel(app.eta_thermoPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_thermoPlot,"$\eta_T$","Interpreter","Latex");

legend(app.eta_thermoPlot,'T_{t7}='+string(T_t7),'Location','northwest','NumColumns',2);

                    plot(app.eta_oPlot,M_0,eta_O(:,:),"LineWidth",1.4);
                    title(app.eta_oPlot,"Efficiency $Graph$","Interpreter","Latex")
                    grid(app.eta_oPlot,'minor')
                    xlabel(app.eta_oPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_oPlot,"$\eta_O$","Interpreter","Latex");

legend(app.eta_oPlot,'T_{t7}='+string(T_t7),'Location','northwest','NumColumns',2);

                case 'Varying Mach No and T_t17'
                    alpha = alpha_min;
```

```
                    M_0 = M_0_min:M_0_increment:M_0_max;
                    pi_f = pi_f_min;
                    pi_c = pi_c_min;
                    T_t4 = T_t4_min;
                    T_t7 = T_t7_min;
                    T_t17 = T_t17_min:T_t17_increment:T_t17_max;
                    tablo = zeros(length(M_0)*length(T_t7),18);

                    for i = 1:length(M_0)
                        for j=1:length(T_t17)

[F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,
j),eta_T(i,j),eta_O(i,j)] = ...

ATFwithSeperateExhausts(app,M_0(i),T_0,gamma_c,c_pc,gamma_t,c_pt,h_PR,...

gamma_AB,c_p_AB,gamma_DB,c_p_DB,pi_d_max,pi_b,pi_AB,pi_DB,pi_n,...

pi_fn,e_c,e_f,e_t,eta_b,eta_AB,eta_DB,eta_m,P_0__P_9,P_0__P_19,...
                                T_t4,T_t7,T_t17(j),pi_c,pi_f,alpha);

                            tablo(length(T_t17)*(i-1)+j,:) = ...
                                [M_0(i),pi_c,pi_f,alpha,T_t4,T_t7,T_t17(j),...

F__mdot_0(i,j),f(i,j),f_AB(i,j),f_DB(i,j),S(i,j),eta_c(i,j),eta_t(i,j),eta_f(i,j),eta_P(i,j
),eta_T(i,j),eta_O(i,j)];

                        end
                    end


                    % Creating Table
                    t =
table(tablo(:,1),tablo(:,2),tablo(:,3),tablo(:,4),tablo(:,5),tablo(:,6),tablo(:,7),...

tablo(:,8),tablo(:,9),tablo(:,10),tablo(:,11),tablo(:,12),tablo(:,13),tablo(:,14),...
                        tablo(:,15),tablo(:,16),tablo(:,17),tablo(:,18));
                    app.UITable.Data = t;
                    vars =
{'M_0','pi_c','pi_f','alpha','T_t4','T_t7','T_t17','F__mdot_0','f','f_AB','f_DB','S','eta_c
','eta_t','eta_f','eta_P','eta_T','eta_O'};
                    app.UITable.ColumnName = vars;

                    % Handling Plots

                    plot(app.FovermdotPlot,M_0,F__mdot_0(:,:),"LineWidth",1.4);
                    title(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
Graph$","Interpreter","Latex")
                    grid(app.FovermdotPlot,'minor')
                    xlabel(app.FovermdotPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.FovermdotPlot,"$\frac{F}{\dot{m}_0}\
[lbf/(lbm/sec)]$","Interpreter","Latex");

legend(app.FovermdotPlot,'T_{t17}='+string(T_t17),'Location','northeast','NumColumns',2);
                    set(app.FovermdotPlot,'Colormap',[1,1,1]);
                    plot(app.SPlot,M_0,S(:,:),"LineWidth",1.4)
                    title(app.SPlot,"S $Graph$","Interpreter","Latex")
                    grid(app.SPlot,'minor')
                    xlabel(app.SPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.SPlot,"$S\ [(lbm/hr)/lbf]$","Interpreter","Latex");

legend(app.SPlot,'T_{t17}='+string(T_t17),'Location','northeast','NumColumns',2);


plot(app.FuelPlot,M_0,f(:,:),M_0,f_AB(:,:),M_0,f_DB(:,:),"LineWidth",1.4);%%
```

```
                    title(app.FuelPlot,"Fuel $Graph$","Interpreter","Latex")
                    grid(app.FuelPlot,'minor')
                    xlabel(app.FuelPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.FuelPlot,"$f,f_{AB},f_{DB}$","Interpreter","Latex");
                    leg = ['f for all T_{t17}'+string(T_t17),'f_{AB} for
T_{t17}='+string(T_t17),'f_{DB} for T_{t17}='+string(T_t17)];
                    legend(app.FuelPlot,leg,'Location','northwest','NumColumns',2);

                    plot(app.eta_cPlot,M_0,eta_c(:,:),"LineWidth",1.4)
                    title(app.eta_cPlot,"$\eta_c$ $Graph$","Interpreter","Latex")
                    grid(app.eta_cPlot,'minor')
                    xlabel(app.eta_cPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.eta_cPlot,"$\eta_c$","Interpreter","Latex");

legend(app.eta_cPlot,'T_{t17}='+string(T_t17),'Location','northeast','NumColumns',2);

                    plot(app.eta_tPlot,M_0,eta_t(:,:),"LineWidth",1.4)
                    title(app.eta_tPlot,"$\eta_t \ Graph$","Interpreter","Latex")
                    grid(app.eta_tPlot,'minor')
                    xlabel(app.eta_tPlot,"$M_0$","Interpreter","Latex");
                    ylabel(app.eta_tPlot,"$\eta_t$","Interpreter","Latex");

legend(app.eta_tPlot,'T_{t17}='+string(T_t17),'Location','northeast','NumColumns',2);

                    plot(app.eta_pPlot,M_0,eta_P(:,:),"LineWidth",1.4);
                    title(app.eta_pPlot," Propulsive Efficiency
$Graph$","Interpreter","Latex")
                    grid(app.eta_pPlot,'minor')
                    xlabel(app.eta_pPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_pPlot,"$\eta_P$","Interpreter","Latex");

legend(app.eta_pPlot,'T_{t17}='+string(T_t17),'Location','northwest','NumColumns',2);

                    plot(app.eta_thermoPlot,M_0,eta_T(:,:),"LineWidth",1.4);
                    title(app.eta_thermoPlot,"Thermal Efficiency
$Graph$","Interpreter","Latex")
                    grid(app.eta_thermoPlot,'minor')
                    xlabel(app.eta_thermoPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_thermoPlot,"$\eta_T$","Interpreter","Latex");

legend(app.eta_thermoPlot,'T_{t17}='+string(T_t17),'Location','northwest','NumColumns',2);

                    plot(app.eta_oPlot,M_0,eta_O(:,:),"LineWidth",1.4);
                    title(app.eta_oPlot,"Efficiency $Graph$","Interpreter","Latex")
                    grid(app.eta_oPlot,'minor')
                    xlabel(app.eta_oPlot,"$ M_0 $","Interpreter","Latex");
                    ylabel(app.eta_oPlot,"$\eta_O$","Interpreter","Latex");

legend(app.eta_oPlot,'T_{t17}='+string(T_t17),'Location','northwest','NumColumns',2);
            end

        end


        % Value changed function: CaseDropDown
        function CaseDropDownValueChanged(app, event)
            value = app.CaseDropDown.Value;

            switch value
                case 'Single Condition'
                    set(app.MachNoIncrementEditField,'enable','off');
                    set(app.MaxMachNumberEditField,'enable','off');
                    set(app.pi_cIncrementEditField,'enable','off');
                    set(app.Maxpi_cValueEditField,'enable','off');
                    set(app.pi_fIncrementEditField,'enable','off');
```

```
        set(app.Maxpi_fEditField,'enable','off');
        set(app.ByPassRatioIncrementEditField,'enable','off');
        set(app.MaxByPassRatioEditField,'enable','off');
        set(app.T_t4IncrementEditField,'enable','off');
        set(app.MaxT_t4KEditField,'enable','off');
        set(app.T_t7IncrementEditField,'enable','off');
        set(app.MaxT_t7KEditField,'enable','off');
        set(app.T_t17IncrementEditField,'enable','off');
        set(app.MaxT_t17KEditField,'enable','off');
        app.MachNumberEditFieldLabel.Text = 'Mach Number';
        app.Minpi_fValueEditFieldLabel.Text = 'pi_f';
        app.MinByPassRatioValueEditFieldLabel.Text = 'By-pass Ratio';
        app.Minpi_cValueLabel.Text = 'pi_c';
        app.MinT_t4KLabel.Text = 'T_t4 (K)';
        app.MinT_t7KLabel.Text = 'T_t7 (K)';
        app.MinT_t17KLabel.Text = 'T_t17 (K)';
        set(app.XAxisSwitch,'enable','off');

    case 'Varying Bypass and pi_f'
        set(app.MachNoIncrementEditField,'enable','off');
        set(app.MaxMachNumberEditField,'enable','off');
        set(app.pi_cIncrementEditField,'enable','off');
        set(app.Maxpi_cValueEditField,'enable','off');
        set(app.pi_fIncrementEditField,'enable','on');
        set(app.Maxpi_fEditField,'enable','on');
        set(app.ByPassRatioIncrementEditField,'enable','on');
        set(app.T_t4IncrementEditField,'enable','off');
        set(app.MaxT_t4KEditField,'enable','off');
        set(app.T_t7IncrementEditField,'enable','off');
        set(app.MaxT_t7KEditField,'enable','off');
        set(app.T_t17IncrementEditField,'enable','off');
        set(app.MaxT_t17KEditField,'enable','off');
        set(app.MaxByPassRatioEditField,'enable','on');
        set(app.XAxisSwitch,'enable','on');
        app.MachNumberEditFieldLabel.Text = 'Mach Number';
        app.Minpi_fValueEditFieldLabel.Text = 'Min pi_f Value';
        app.MinByPassRatioValueEditFieldLabel.Text = 'Min By-pass Ratio';
        app.Minpi_cValueLabel.Text = 'pi_c';
        app.MinT_t4KLabel.Text = 'T_t4 (K)';
        app.MinT_t7KLabel.Text = 'T_t7 (K)';
        app.MinT_t17KLabel.Text = 'T_t17 (K)';
        app.XAxisSwitch.Items = {'alpha','pi_f'};

    case 'Varying pi_f and pi_c'
        set(app.MachNoIncrementEditField,'enable','off');
        set(app.MaxMachNumberEditField,'enable','off');
        set(app.pi_cIncrementEditField,'enable','on');
        set(app.Maxpi_cValueEditField,'enable','on');
        set(app.pi_fIncrementEditField,'enable','on');
        set(app.Maxpi_fEditField,'enable','on');
        set(app.ByPassRatioIncrementEditField,'enable','off');
        set(app.MaxByPassRatioEditField,'enable','off');
        set(app.T_t4IncrementEditField,'enable','off');
        set(app.MaxT_t4KEditField,'enable','off');
        set(app.T_t7IncrementEditField,'enable','off');
        set(app.MaxT_t7KEditField,'enable','off');
        set(app.T_t17IncrementEditField,'enable','off');
        set(app.MaxT_t17KEditField,'enable','off');
        set(app.XAxisSwitch,'enable','on');
        app.MachNumberEditFieldLabel.Text = 'Mach Number';
        app.Minpi_fValueEditFieldLabel.Text = 'Min pi_f Value';
        app.MinByPassRatioValueEditFieldLabel.Text = 'By-pass Ratio';
        app.Minpi_cValueLabel.Text = 'Min pi_c Value';
        app.MinT_t4KLabel.Text = 'T_t4 (K)';
        app.MinT_t7KLabel.Text = 'T_t7 (K)';
```

```
        app.MinT_t17KLabel.Text = 'T_t17 (K)';
        app.XAxisSwitch.Items = {'pi_f','pi_c'};
    case 'Varying Bypass and pi_c'

        set(app.MachNoIncrementEditField,'enable','off');
        set(app.MaxMachNumberEditField,'enable','off');
        set(app.pi_cIncrementEditField,'enable','on');
        set(app.Maxpi_cValueEditField,'enable','on');
        set(app.pi_fIncrementEditField,'enable','off');
        set(app.Maxpi_fEditField,'enable','off');
        set(app.ByPassRatioIncrementEditField,'enable','on');
        set(app.MaxByPassRatioEditField,'enable','on');
        set(app.T_t4IncrementEditField,'enable','off');
        set(app.MaxT_t4KEditField,'enable','off');
        set(app.T_t7IncrementEditField,'enable','off');
        set(app.MaxT_t7KEditField,'enable','off');
        set(app.T_t17IncrementEditField,'enable','off');
        set(app.MaxT_t17KEditField,'enable','off');
        set(app.XAxisSwitch,'enable','on');
        app.MachNumberEditFieldLabel.Text = 'Mach Number';
        app.Minpi_fValueEditFieldLabel.Text = 'pi_f Value';
        app.MinByPassRatioValueEditFieldLabel.Text = 'Min By-pass Ratio';
        app.Minpi_cValueLabel.Text = 'Min pi_c Value';
        app.MinT_t4KLabel.Text = 'T_t4 (K)';
        app.MinT_t7KLabel.Text = 'T_t7 (K)';
        app.MinT_t17KLabel.Text = 'T_t17 (K)';
        app.XAxisSwitch.Items = {'pi_c','alpha'};

    case 'Varying Mach No and pi_c'
        set(app.MachNoIncrementEditField,'enable','on');
        set(app.MaxMachNumberEditField,'enable','on');
        set(app.pi_cIncrementEditField,'enable','on');
        set(app.Maxpi_cValueEditField,'enable','on');
        set(app.pi_fIncrementEditField,'enable','off');
        set(app.Maxpi_fEditField,'enable','off');
        set(app.ByPassRatioIncrementEditField,'enable','off');
        set(app.MaxByPassRatioEditField,'enable','off');
        set(app.T_t4IncrementEditField,'enable','off');
        set(app.MaxT_t4KEditField,'enable','off');
        set(app.T_t7IncrementEditField,'enable','off');
        set(app.MaxT_t7KEditField,'enable','off');
        set(app.T_t17IncrementEditField,'enable','off');
        set(app.MaxT_t17KEditField,'enable','off');
        set(app.XAxisSwitch,'enable','off');
        app.MachNumberEditFieldLabel.Text = 'Min Mach Number';
        app.Minpi_fValueEditFieldLabel.Text = 'pi_f Value';
        app.MinByPassRatioValueEditFieldLabel.Text = 'By-pass Ratio';
        app.Minpi_cValueLabel.Text = 'Min pi_c Value';
        app.MinT_t4KLabel.Text = 'T_t4 (K)';
        app.MinT_t7KLabel.Text = 'T_t7 (K)';
        app.MinT_t17KLabel.Text = 'T_t17 (K)';
        app.XAxisSwitch.Items = {'M_0','pi_c'};

    case 'Varying Mach No and Bypass'
        set(app.MachNoIncrementEditField,'enable','on');
        set(app.MaxMachNumberEditField,'enable','on');
        set(app.pi_cIncrementEditField,'enable','off');
        set(app.Maxpi_cValueEditField,'enable','off');
        set(app.pi_fIncrementEditField,'enable','off');
        set(app.Maxpi_fEditField,'enable','off');
        set(app.ByPassRatioIncrementEditField,'enable','on');
        set(app.MaxByPassRatioEditField,'enable','on');
        set(app.T_t4IncrementEditField,'enable','off');
        set(app.MaxT_t4KEditField,'enable','off');
        set(app.T_t7IncrementEditField,'enable','off');
```

```
        set(app.MaxT_t7KEditField,'enable','off');
        set(app.T_t17IncrementEditField,'enable','off');
        set(app.MaxT_t17KEditField,'enable','off');
        set(app.XAxisSwitch,'enable','off');
        app.MachNumberEditFieldLabel.Text = 'Min Mach Number';
        app.Minpi_fValueEditFieldLabel.Text = 'pi_f Value';
        app.MinByPassRatioValueEditFieldLabel.Text = 'Min By-pass Ratio';
        app.Minpi_cValueLabel.Text = 'pi_c Value';
        app.MinT_t4KLabel.Text = 'T_t4 (K)';
        app.MinT_t7KLabel.Text = 'T_t7 (K)';
        app.MinT_t17KLabel.Text = 'T_t17 (K)';
        app.XAxisSwitch.Items = {'M_0','alpha'};

    case 'Varying Mach No and pi_f'
        set(app.MachNoIncrementEditField,'enable','on');
        set(app.MaxMachNumberEditField,'enable','on');
        set(app.pi_cIncrementEditField,'enable','off');
        set(app.Maxpi_cValueEditField,'enable','off');
        set(app.pi_fIncrementEditField,'enable','on');
        set(app.Maxpi_fEditField,'enable','on');
        set(app.ByPassRatioIncrementEditField,'enable','off');
        set(app.MaxByPassRatioEditField,'enable','off');
        set(app.T_t4IncrementEditField,'enable','off');
        set(app.MaxT_t4KEditField,'enable','off');
        set(app.T_t7IncrementEditField,'enable','off');
        set(app.MaxT_t7KEditField,'enable','off');
        set(app.T_t17IncrementEditField,'enable','off');
        set(app.MaxT_t17KEditField,'enable','off');
        set(app.XAxisSwitch,'enable','off');
        app.MachNumberEditFieldLabel.Text = 'Min Mach Number';
        app.Minpi_fValueEditFieldLabel.Text = 'Min pi_f Value';
        app.MinByPassRatioValueEditFieldLabel.Text = 'By-pass Ratio';
        app.Minpi_cValueLabel.Text = 'pi_c Value';
        app.MinT_t4KLabel.Text = 'T_t4 (K)';
        app.MinT_t7KLabel.Text = 'T_t7 (K)';
        app.MinT_t17KLabel.Text = 'T_t17 (K)';
        app.XAxisSwitch.Items = {'M_0','pi_F'};

    case 'Varying Mach No and T_t4'
        set(app.MachNoIncrementEditField,'enable','on');
        set(app.MaxMachNumberEditField,'enable','on');
        set(app.pi_cIncrementEditField,'enable','off');
        set(app.Maxpi_cValueEditField,'enable','off');
        set(app.pi_fIncrementEditField,'enable','off');
        set(app.Maxpi_fEditField,'enable','off');
        set(app.ByPassRatioIncrementEditField,'enable','off');
        set(app.MaxByPassRatioEditField,'enable','off');
        set(app.T_t4IncrementEditField,'enable','on');
        set(app.MaxT_t4KEditField,'enable','on');
        set(app.T_t7IncrementEditField,'enable','off');
        set(app.MaxT_t7KEditField,'enable','off');
        set(app.T_t17IncrementEditField,'enable','off');
        set(app.MaxT_t17KEditField,'enable','off');
        set(app.XAxisSwitch,'enable','off');
        app.MachNumberEditFieldLabel.Text = 'Min Mach Number';
        app.Minpi_fValueEditFieldLabel.Text = 'pi_f Value';
        app.MinByPassRatioValueEditFieldLabel.Text = 'By-pass Ratio';
        app.Minpi_cValueLabel.Text = 'pi_c Value';
        app.MinT_t4KLabel.Text = 'Min T_t4 (K)';
        app.MinT_t7KLabel.Text = 'T_t7 (K)';
        app.MinT_t17KLabel.Text = 'T_t17 (K)';
        app.XAxisSwitch.Items = {'M_0','T_t4'};

    case 'Varying Mach No and T_t7'
        set(app.MachNoIncrementEditField,'enable','on');
```

```
                    set(app.MaxMachNumberEditField,'enable','on');
                    set(app.pi_cIncrementEditField,'enable','off');
                    set(app.Maxpi_cValueEditField,'enable','off');
                    set(app.pi_fIncrementEditField,'enable','off');
                    set(app.Maxpi_fEditField,'enable','off');
                    set(app.ByPassRatioIncrementEditField,'enable','off');
                    set(app.MaxByPassRatioEditField,'enable','off');
                    set(app.T_t4IncrementEditField,'enable','off');
                    set(app.MaxT_t4KEditField,'enable','off');
                    set(app.T_t7IncrementEditField,'enable','on');
                    set(app.MaxT_t7KEditField,'enable','on');
                    set(app.T_t17IncrementEditField,'enable','off');
                    set(app.MaxT_t17KEditField,'enable','off');
                    set(app.XAxisSwitch,'enable','off');
                    app.MachNumberEditFieldLabel.Text = 'Min Mach Number';
                    app.Minpi_fValueEditFieldLabel.Text = 'pi_f Value';
                    app.MinByPassRatioValueEditFieldLabel.Text = 'By-pass Ratio';
                    app.Minpi_cValueLabel.Text = 'pi_c Value';
                    app.MinT_t4KLabel.Text = 'T_t4 (K)';
                    app.MinT_t7KLabel.Text = 'Min T_t7 (K)';
                    app.MinT_t17KLabel.Text = 'T_t17 (K)';
                    app.XAxisSwitch.Items = {'M_0','T_t7'};

                case 'Varying Mach No and T_t17'
                    set(app.MachNoIncrementEditField,'enable','on');
                    set(app.MaxMachNumberEditField,'enable','on');
                    set(app.pi_cIncrementEditField,'enable','off');
                    set(app.Maxpi_cValueEditField,'enable','off');
                    set(app.pi_fIncrementEditField,'enable','off');
                    set(app.Maxpi_fEditField,'enable','off');
                    set(app.ByPassRatioIncrementEditField,'enable','off');
                    set(app.MaxByPassRatioEditField,'enable','off');
                    set(app.T_t4IncrementEditField,'enable','off');
                    set(app.MaxT_t4KEditField,'enable','off');
                    set(app.T_t7IncrementEditField,'enable','off');
                    set(app.MaxT_t7KEditField,'enable','off');
                    set(app.T_t17IncrementEditField,'enable','on');
                    set(app.MaxT_t17KEditField,'enable','on');
                    set(app.XAxisSwitch,'enable','off');
                    app.MachNumberEditFieldLabel.Text = 'Min Mach Number';
                    app.Minpi_fValueEditFieldLabel.Text = 'pi_f Value';
                    app.MinByPassRatioValueEditFieldLabel.Text = 'By-pass Ratio';
                    app.Minpi_cValueLabel.Text = 'pi_c Value';
                    app.MinT_t4KLabel.Text = 'T_t4 (K)';
                    app.MinT_t7KLabel.Text = 'T_t7 (K)';
                    app.MinT_t17KLabel.Text = 'Min T_t17 (K)';
                    app.XAxisSwitch.Items = {'M_0','T_t17'};
            end
        end
    end


    % Component initialization
    methods (Access = private)


        % Create UIFigure and components
        function createComponents(app)


            % Create AfterburnerTurbofan and hide until all components are created
            app.AfterburnerTurbofan = uifigure('Visible', 'off');
            app.AfterburnerTurbofan.Position = [100 100 1130 708];
            app.AfterburnerTurbofan.Name = 'UI Figure';
```

```
% Create FlightConditionsPanel
app.FlightConditionsPanel = uipanel(app.AfterburnerTurbofan);
app.FlightConditionsPanel.TitlePosition = 'centertop';
app.FlightConditionsPanel.Title = 'Flight Conditions';
app.FlightConditionsPanel.FontWeight = 'bold';
app.FlightConditionsPanel.Position = [21 376 264 261];

% Create GridLayout
app.GridLayout = uigridlayout(app.FlightConditionsPanel);
app.GridLayout.RowHeight = {'1x', '1x', '1x', '1x', '1x', '1x', '1x', '1x'};

% Create T_0KEditFieldLabel
app.T_0KEditFieldLabel = uilabel(app.GridLayout);
app.T_0KEditFieldLabel.HorizontalAlignment = 'center';
app.T_0KEditFieldLabel.Layout.Row = 4;
app.T_0KEditFieldLabel.Layout.Column = 1;
app.T_0KEditFieldLabel.Text = 'T_0 (K)';

% Create T_0KEditField
app.T_0KEditField = uieditfield(app.GridLayout, 'numeric');
app.T_0KEditField.HorizontalAlignment = 'center';
app.T_0KEditField.Layout.Row = 4;
app.T_0KEditField.Layout.Column = 2;
app.T_0KEditField.Value = 216.6667;

% Create MachNumberEditFieldLabel
app.MachNumberEditFieldLabel = uilabel(app.GridLayout);
app.MachNumberEditFieldLabel.HorizontalAlignment = 'center';
app.MachNumberEditFieldLabel.Layout.Row = 1;
app.MachNumberEditFieldLabel.Layout.Column = 1;
app.MachNumberEditFieldLabel.Text = 'Mach Number';

% Create MachNumberMinEditField
app.MachNumberMinEditField = uieditfield(app.GridLayout, 'numeric');
app.MachNumberMinEditField.HorizontalAlignment = 'center';
app.MachNumberMinEditField.Layout.Row = 1;
app.MachNumberMinEditField.Layout.Column = 2;
app.MachNumberMinEditField.Value = 1.6;

% Create P_0P_9EditFieldLabel
app.P_0P_9EditFieldLabel = uilabel(app.GridLayout);
app.P_0P_9EditFieldLabel.HorizontalAlignment = 'center';
app.P_0P_9EditFieldLabel.Layout.Row = 7;
app.P_0P_9EditFieldLabel.Layout.Column = 1;
app.P_0P_9EditFieldLabel.Text = 'P_0/P_9';

% Create P_0P_9EditField
app.P_0P_9EditField = uieditfield(app.GridLayout, 'numeric');
app.P_0P_9EditField.HorizontalAlignment = 'center';
app.P_0P_9EditField.Layout.Row = 7;
app.P_0P_9EditField.Layout.Column = 2;
app.P_0P_9EditField.Value = 1;

% Create P_0P_19EditFieldLabel
app.P_0P_19EditFieldLabel = uilabel(app.GridLayout);
app.P_0P_19EditFieldLabel.HorizontalAlignment = 'center';
```

```
app.P_0P_19EditFieldLabel.Layout.Row = 8;
app.P_0P_19EditFieldLabel.Layout.Column = 1;
app.P_0P_19EditFieldLabel.Text = 'P_0/P_19';


% Create P_0P_19EditField
app.P_0P_19EditField = uieditfield(app.GridLayout, 'numeric');
app.P_0P_19EditField.HorizontalAlignment = 'center';
app.P_0P_19EditField.Layout.Row = 8;
app.P_0P_19EditField.Layout.Column = 2;
app.P_0P_19EditField.Value = 1;


% Create gamma_cEditFieldLabel
app.gamma_cEditFieldLabel = uilabel(app.GridLayout);
app.gamma_cEditFieldLabel.HorizontalAlignment = 'center';
app.gamma_cEditFieldLabel.Layout.Row = 5;
app.gamma_cEditFieldLabel.Layout.Column = 1;
app.gamma_cEditFieldLabel.Text = 'gamma_c';


% Create gamma_cEditField
app.gamma_cEditField = uieditfield(app.GridLayout, 'numeric');
app.gamma_cEditField.HorizontalAlignment = 'center';
app.gamma_cEditField.Layout.Row = 5;
app.gamma_cEditField.Layout.Column = 2;
app.gamma_cEditField.Value = 1.4;


% Create c_pckJkgKLabel
app.c_pckJkgKLabel = uilabel(app.GridLayout);
app.c_pckJkgKLabel.HorizontalAlignment = 'center';
app.c_pckJkgKLabel.Layout.Row = 6;
app.c_pckJkgKLabel.Layout.Column = 1;
app.c_pckJkgKLabel.Text = 'c_pc (kJ/(kg.K))';


% Create c_pckJkgKEditField
app.c_pckJkgKEditField = uieditfield(app.GridLayout, 'numeric');
app.c_pckJkgKEditField.HorizontalAlignment = 'center';
app.c_pckJkgKEditField.Layout.Row = 6;
app.c_pckJkgKEditField.Layout.Column = 2;
app.c_pckJkgKEditField.Value = 1.0048;


% Create MaxMachNumberEditFieldLabel
app.MaxMachNumberEditFieldLabel = uilabel(app.GridLayout);
app.MaxMachNumberEditFieldLabel.HorizontalAlignment = 'center';
app.MaxMachNumberEditFieldLabel.Layout.Row = 3;
app.MaxMachNumberEditFieldLabel.Layout.Column = 1;
app.MaxMachNumberEditFieldLabel.Text = 'Max Mach Number';


% Create MaxMachNumberEditField
app.MaxMachNumberEditField = uieditfield(app.GridLayout, 'numeric');
app.MaxMachNumberEditField.HorizontalAlignment = 'center';
app.MaxMachNumberEditField.Layout.Row = 3;
app.MaxMachNumberEditField.Layout.Column = 2;
app.MaxMachNumberEditField.Value = 2.5;


% Create MachNoIncrementEditFieldLabel
app.MachNoIncrementEditFieldLabel = uilabel(app.GridLayout);
app.MachNoIncrementEditFieldLabel.HorizontalAlignment = 'center';
```

```
app.MachNoIncrementEditFieldLabel.Layout.Row = 2;
app.MachNoIncrementEditFieldLabel.Layout.Column = 1;
app.MachNoIncrementEditFieldLabel.Text = 'Mach No Increment';


% Create MachNoIncrementEditField
app.MachNoIncrementEditField = uieditfield(app.GridLayout, 'numeric');
app.MachNoIncrementEditField.HorizontalAlignment = 'center';
app.MachNoIncrementEditField.Layout.Row = 2;
app.MachNoIncrementEditField.Layout.Column = 2;
app.MachNoIncrementEditField.Value = 0.1;


% Create TabGroup
app.TabGroup = uitabgroup(app.AfterburnerTurbofan);
app.TabGroup.Position = [287 30 816 398];


% Create Table
app.Table = uitab(app.TabGroup);
app.Table.Title = 'Table';


% Create UITable
app.UITable = uitable(app.Table);
app.UITable.ColumnName = {'F/mdot'; 'S'; 'f'; 'f_AB'; 'f_DB'; 'eta_c'; 'eta_t';
'eta_f'};

app.UITable.RowName = {};
app.UITable.FontWeight = 'bold';
app.UITable.Position = [4 4 750 367];


% Create Fm_0dotTab
app.Fm_0dotTab = uitab(app.TabGroup);
app.Fm_0dotTab.Title = 'F/m_0dot';


% Create FovermdotPlot
app.FovermdotPlot = uiaxes(app.Fm_0dotTab);
title(app.FovermdotPlot, 'F/m_0dot')
xlabel(app.FovermdotPlot, 'pi_f')
ylabel(app.FovermdotPlot, 'F/m_0dot')
app.FovermdotPlot.Position = [59 18 651 352];


% Create STab
app.STab = uitab(app.TabGroup);
app.STab.Title = 'S';


% Create SPlot
app.SPlot = uiaxes(app.STab);
title(app.SPlot, 'Title')
xlabel(app.SPlot, 'X')
ylabel(app.SPlot, 'Y')
app.SPlot.Position = [64 17 641 347];


% Create FuelAirRatioTab
app.FuelAirRatioTab = uitab(app.TabGroup);
app.FuelAirRatioTab.Title = 'Fuel-Air Ratio';


% Create FuelPlot
```

```
app.FuelPlot = uiaxes(app.FuelAirRatioTab);
title(app.FuelPlot, 'Title')
xlabel(app.FuelPlot, 'X')
ylabel(app.FuelPlot, 'Y')
app.FuelPlot.Position = [58 7 721 358];


% Create Eta_cTab
app.Eta_cTab = uitab(app.TabGroup);
app.Eta_cTab.Title = 'Eta_c';


% Create eta_cPlot
app.eta_cPlot = uiaxes(app.Eta_cTab);
title(app.eta_cPlot, 'Title')
xlabel(app.eta_cPlot, 'X')
ylabel(app.eta_cPlot, 'Y')
app.eta_cPlot.Position = [32 10 744 341];


% Create Eta_tTab
app.Eta_tTab = uitab(app.TabGroup);
app.Eta_tTab.Title = 'Eta_t';


% Create eta_tPlot
app.eta_tPlot = uiaxes(app.Eta_tTab);
title(app.eta_tPlot, 'Title')
xlabel(app.eta_tPlot, 'X')
ylabel(app.eta_tPlot, 'Y')
app.eta_tPlot.PlotBoxAspectRatio = [2.52747252747253 1 1];
app.eta_tPlot.YTick = [0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1];
app.eta_tPlot.Position = [44 23 719 325];


% Create PropulsiveEfficiencyTab
app.PropulsiveEfficiencyTab = uitab(app.TabGroup);
app.PropulsiveEfficiencyTab.Title = 'Propulsive Efficiency';


% Create GridLayout7
app.GridLayout7 = uigridlayout(app.PropulsiveEfficiencyTab);
app.GridLayout7.ColumnWidth = {'1x'};
app.GridLayout7.RowHeight = {'1x'};
app.GridLayout7.Padding = [10 11.004638671875 10 11.004638671875];


% Create eta_pPlot
app.eta_pPlot = uiaxes(app.GridLayout7);
title(app.eta_pPlot, 'Title')
xlabel(app.eta_pPlot, 'X')
ylabel(app.eta_pPlot, 'Y')
app.eta_pPlot.PlotBoxAspectRatio = [2.50815217391304 1 1];
app.eta_pPlot.Layout.Row = 1;
app.eta_pPlot.Layout.Column = 1;


% Create TermalEfficiencyTab
app.TermalEfficiencyTab = uitab(app.TabGroup);
app.TermalEfficiencyTab.Title = 'Termal Efficiency';


% Create eta_thermoPlot
app.eta_thermoPlot = uiaxes(app.TermalEfficiencyTab);
```

```
title(app.eta_thermoPlot, 'Title')
xlabel(app.eta_thermoPlot, 'X')
ylabel(app.eta_thermoPlot, 'Y')
app.eta_thermoPlot.Position = [17 12 788 346];


% Create OverallEfficiencyTab
app.OverallEfficiencyTab = uitab(app.TabGroup);
app.OverallEfficiencyTab.Title = 'Overall Efficiency';


% Create eta_oPlot
app.eta_oPlot = uiaxes(app.OverallEfficiencyTab);
title(app.eta_oPlot, 'Title')
xlabel(app.eta_oPlot, 'X')
ylabel(app.eta_oPlot, 'Y')
app.eta_oPlot.Position = [8 12 797 346];


% Create DesignConstraintsPanel
app.DesignConstraintsPanel = uipanel(app.AfterburnerTurbofan);
app.DesignConstraintsPanel.TitlePosition = 'centertop';
app.DesignConstraintsPanel.Title = 'Design Constraints';
app.DesignConstraintsPanel.FontWeight = 'bold';
app.DesignConstraintsPanel.Position = [286 428 215 267];


% Create GridLayout2
app.GridLayout2 = uigridlayout(app.DesignConstraintsPanel);
app.GridLayout2.RowHeight = {'1x', '1x', '1x', '1x', '1x', '1x', '1x', '1x',
'1x'};

app.GridLayout2.ColumnSpacing = 7.33443196614583;
app.GridLayout2.Padding = [7.33443196614583 10 7.33443196614583 10];


% Create MinT_t4KLabel
app.MinT_t4KLabel = uilabel(app.GridLayout2);
app.MinT_t4KLabel.HorizontalAlignment = 'center';
app.MinT_t4KLabel.Layout.Row = 1;
app.MinT_t4KLabel.Layout.Column = 1;
app.MinT_t4KLabel.Text = 'Min T_t4 (K)';


% Create MinT_t4KEditField
app.MinT_t4KEditField = uieditfield(app.GridLayout2, 'numeric');
app.MinT_t4KEditField.HorizontalAlignment = 'center';
app.MinT_t4KEditField.Layout.Row = 1;
app.MinT_t4KEditField.Layout.Column = 2;
app.MinT_t4KEditField.Value = 1944.4;


% Create MinT_t17KLabel
app.MinT_t17KLabel = uilabel(app.GridLayout2);
app.MinT_t17KLabel.HorizontalAlignment = 'center';
app.MinT_t17KLabel.Layout.Row = 7;
app.MinT_t17KLabel.Layout.Column = 1;
app.MinT_t17KLabel.Text = 'Min T_t17 (K)';


% Create MinT_t17KEditField
app.MinT_t17KEditField = uieditfield(app.GridLayout2, 'numeric');
app.MinT_t17KEditField.HorizontalAlignment = 'center';
app.MinT_t17KEditField.Layout.Row = 7;
app.MinT_t17KEditField.Layout.Column = 2;
```

```
app.MinT_t17KEditField.Value = 2222.2;


% Create MinT_t7KLabel
app.MinT_t7KLabel = uilabel(app.GridLayout2);
app.MinT_t7KLabel.HorizontalAlignment = 'center';
app.MinT_t7KLabel.Layout.Row = 4;
app.MinT_t7KLabel.Layout.Column = 1;
app.MinT_t7KLabel.Text = 'Min T_t7 (K)';


% Create MinT_t7KEditField
app.MinT_t7KEditField = uieditfield(app.GridLayout2, 'numeric');
app.MinT_t7KEditField.HorizontalAlignment = 'center';
app.MinT_t7KEditField.Layout.Row = 4;
app.MinT_t7KEditField.Layout.Column = 2;
app.MinT_t7KEditField.Value = 2222.2;


% Create T_t4IncrementEditFieldLabel
app.T_t4IncrementEditFieldLabel = uilabel(app.GridLayout2);
app.T_t4IncrementEditFieldLabel.HorizontalAlignment = 'center';
app.T_t4IncrementEditFieldLabel.Layout.Row = 2;
app.T_t4IncrementEditFieldLabel.Layout.Column = 1;
app.T_t4IncrementEditFieldLabel.Text = 'T_t4 Increment';


% Create T_t4IncrementEditField
app.T_t4IncrementEditField = uieditfield(app.GridLayout2, 'numeric');
app.T_t4IncrementEditField.HorizontalAlignment = 'center';
app.T_t4IncrementEditField.Layout.Row = 2;
app.T_t4IncrementEditField.Layout.Column = 2;
app.T_t4IncrementEditField.Value = 50;


% Create MaxT_t4KEditFieldLabel
app.MaxT_t4KEditFieldLabel = uilabel(app.GridLayout2);
app.MaxT_t4KEditFieldLabel.HorizontalAlignment = 'center';
app.MaxT_t4KEditFieldLabel.Layout.Row = 3;
app.MaxT_t4KEditFieldLabel.Layout.Column = 1;
app.MaxT_t4KEditFieldLabel.Text = 'Max T_t4 (K)';


% Create MaxT_t4KEditField
app.MaxT_t4KEditField = uieditfield(app.GridLayout2, 'numeric');
app.MaxT_t4KEditField.HorizontalAlignment = 'center';
app.MaxT_t4KEditField.Layout.Row = 3;
app.MaxT_t4KEditField.Layout.Column = 2;
app.MaxT_t4KEditField.Value = 2100;


% Create T_t7IncrementEditFieldLabel
app.T_t7IncrementEditFieldLabel = uilabel(app.GridLayout2);
app.T_t7IncrementEditFieldLabel.HorizontalAlignment = 'right';
app.T_t7IncrementEditFieldLabel.Layout.Row = 5;
app.T_t7IncrementEditFieldLabel.Layout.Column = 1;
app.T_t7IncrementEditFieldLabel.Text = 'T_t7 Increment';


% Create T_t7IncrementEditField
app.T_t7IncrementEditField = uieditfield(app.GridLayout2, 'numeric');
app.T_t7IncrementEditField.HorizontalAlignment = 'center';
app.T_t7IncrementEditField.Layout.Row = 5;
app.T_t7IncrementEditField.Layout.Column = 2;
```

```
app.T_t7IncrementEditField.Value = 50;


% Create MaxT_t7KEditFieldLabel
app.MaxT_t7KEditFieldLabel = uilabel(app.GridLayout2);
app.MaxT_t7KEditFieldLabel.HorizontalAlignment = 'center';
app.MaxT_t7KEditFieldLabel.Layout.Row = 6;
app.MaxT_t7KEditFieldLabel.Layout.Column = 1;
app.MaxT_t7KEditFieldLabel.Text = 'Max T_t7 (K)';


% Create MaxT_t7KEditField
app.MaxT_t7KEditField = uieditfield(app.GridLayout2, 'numeric');
app.MaxT_t7KEditField.HorizontalAlignment = 'center';
app.MaxT_t7KEditField.Layout.Row = 6;
app.MaxT_t7KEditField.Layout.Column = 2;
app.MaxT_t7KEditField.Value = 2350;


% Create T_t17IncrementEditFieldLabel
app.T_t17IncrementEditFieldLabel = uilabel(app.GridLayout2);
app.T_t17IncrementEditFieldLabel.HorizontalAlignment = 'center';
app.T_t17IncrementEditFieldLabel.Layout.Row = 8;
app.T_t17IncrementEditFieldLabel.Layout.Column = 1;
app.T_t17IncrementEditFieldLabel.Text = 'T_t17 Increment';


% Create T_t17IncrementEditField
app.T_t17IncrementEditField = uieditfield(app.GridLayout2, 'numeric');
app.T_t17IncrementEditField.HorizontalAlignment = 'center';
app.T_t17IncrementEditField.Layout.Row = 8;
app.T_t17IncrementEditField.Layout.Column = 2;
app.T_t17IncrementEditField.Value = 50;


% Create MaxT_t17KEditFieldLabel
app.MaxT_t17KEditFieldLabel = uilabel(app.GridLayout2);
app.MaxT_t17KEditFieldLabel.HorizontalAlignment = 'center';
app.MaxT_t17KEditFieldLabel.Layout.Row = 9;
app.MaxT_t17KEditFieldLabel.Layout.Column = 1;
app.MaxT_t17KEditFieldLabel.Text = 'Max T_t17 (K)';


% Create MaxT_t17KEditField
app.MaxT_t17KEditField = uieditfield(app.GridLayout2, 'numeric');
app.MaxT_t17KEditField.HorizontalAlignment = 'center';
app.MaxT_t17KEditField.Layout.Row = 9;
app.MaxT_t17KEditField.Layout.Column = 2;
app.MaxT_t17KEditField.Value = 2350;


% Create ComponentPerformancesPanel
app.ComponentPerformancesPanel = uipanel(app.AfterburnerTurbofan);
app.ComponentPerformancesPanel.TitlePosition = 'centertop';
app.ComponentPerformancesPanel.Title = 'Component Performances';
app.ComponentPerformancesPanel.FontWeight = 'bold';
app.ComponentPerformancesPanel.Position = [747 427 356 267];


% Create GridLayout3
app.GridLayout3 = uigridlayout(app.ComponentPerformancesPanel);
app.GridLayout3.ColumnWidth = {'1x', '1x', '1x', '1x'};
app.GridLayout3.RowHeight = {'1x', '1x', '1x', '1x', '1x', '1x', '1x'};
```

```
% Create pi_bEditFieldLabel
app.pi_bEditFieldLabel = uilabel(app.GridLayout3);
app.pi_bEditFieldLabel.HorizontalAlignment = 'center';
app.pi_bEditFieldLabel.Layout.Row = 1;
app.pi_bEditFieldLabel.Layout.Column = 3;
app.pi_bEditFieldLabel.Text = 'pi_b';


% Create pi_bEditField
app.pi_bEditField = uieditfield(app.GridLayout3, 'numeric');
app.pi_bEditField.HorizontalAlignment = 'center';
app.pi_bEditField.Layout.Row = 1;
app.pi_bEditField.Layout.Column = 4;
app.pi_bEditField.Value = 0.98;


% Create eta_ABEditFieldLabel
app.eta_ABEditFieldLabel = uilabel(app.GridLayout3);
app.eta_ABEditFieldLabel.HorizontalAlignment = 'center';
app.eta_ABEditFieldLabel.Layout.Row = 6;
app.eta_ABEditFieldLabel.Layout.Column = 1;
app.eta_ABEditFieldLabel.Text = 'eta_AB';


% Create eta_ABEditField
app.eta_ABEditField = uieditfield(app.GridLayout3, 'numeric');
app.eta_ABEditField.HorizontalAlignment = 'center';
app.eta_ABEditField.Layout.Row = 6;
app.eta_ABEditField.Layout.Column = 2;
app.eta_ABEditField.Value = 0.95;


% Create eta_DBEditFieldLabel
app.eta_DBEditFieldLabel = uilabel(app.GridLayout3);
app.eta_DBEditFieldLabel.HorizontalAlignment = 'center';
app.eta_DBEditFieldLabel.Layout.Row = 6;
app.eta_DBEditFieldLabel.Layout.Column = 3;
app.eta_DBEditFieldLabel.Text = 'eta_DB';


% Create eta_DBEditField
app.eta_DBEditField = uieditfield(app.GridLayout3, 'numeric');
app.eta_DBEditField.HorizontalAlignment = 'center';
app.eta_DBEditField.Layout.Row = 6;
app.eta_DBEditField.Layout.Column = 4;
app.eta_DBEditField.Value = 0.95;


% Create eta_mEditFieldLabel
app.eta_mEditFieldLabel = uilabel(app.GridLayout3);
app.eta_mEditFieldLabel.HorizontalAlignment = 'center';
app.eta_mEditFieldLabel.Layout.Row = 7;
app.eta_mEditFieldLabel.Layout.Column = 1;
app.eta_mEditFieldLabel.Text = 'eta_m';


% Create eta_mEditField
app.eta_mEditField = uieditfield(app.GridLayout3, 'numeric');
app.eta_mEditField.HorizontalAlignment = 'center';
app.eta_mEditField.Layout.Row = 7;
app.eta_mEditField.Layout.Column = 2;
app.eta_mEditField.Value = 0.99;
```

```
% Create eta_bEditFieldLabel
app.eta_bEditFieldLabel = uilabel(app.GridLayout3);
app.eta_bEditFieldLabel.HorizontalAlignment = 'center';
app.eta_bEditFieldLabel.Layout.Row = 5;
app.eta_bEditFieldLabel.Layout.Column = 3;
app.eta_bEditFieldLabel.Text = 'eta_b';


% Create eta_bEditField
app.eta_bEditField = uieditfield(app.GridLayout3, 'numeric');
app.eta_bEditField.HorizontalAlignment = 'center';
app.eta_bEditField.Layout.Row = 5;
app.eta_bEditField.Layout.Column = 4;
app.eta_bEditField.Value = 0.99;


% Create pi_DBEditFieldLabel
app.pi_DBEditFieldLabel = uilabel(app.GridLayout3);
app.pi_DBEditFieldLabel.HorizontalAlignment = 'center';
app.pi_DBEditFieldLabel.Layout.Row = 2;
app.pi_DBEditFieldLabel.Layout.Column = 3;
app.pi_DBEditFieldLabel.Text = 'pi_DB';


% Create pi_DBEditField
app.pi_DBEditField = uieditfield(app.GridLayout3, 'numeric');
app.pi_DBEditField.HorizontalAlignment = 'center';
app.pi_DBEditField.Layout.Row = 2;
app.pi_DBEditField.Layout.Column = 4;
app.pi_DBEditField.Value = 0.94;


% Create pi_d_maxEditFieldLabel
app.pi_d_maxEditFieldLabel = uilabel(app.GridLayout3);
app.pi_d_maxEditFieldLabel.HorizontalAlignment = 'center';
app.pi_d_maxEditFieldLabel.Layout.Row = 1;
app.pi_d_maxEditFieldLabel.Layout.Column = 1;
app.pi_d_maxEditFieldLabel.Text = 'pi_d_max';


% Create pi_d_maxEditField
app.pi_d_maxEditField = uieditfield(app.GridLayout3, 'numeric');
app.pi_d_maxEditField.HorizontalAlignment = 'center';
app.pi_d_maxEditField.Layout.Row = 1;
app.pi_d_maxEditField.Layout.Column = 2;
app.pi_d_maxEditField.Value = 0.98;


% Create e_cEditFieldLabel
app.e_cEditFieldLabel = uilabel(app.GridLayout3);
app.e_cEditFieldLabel.HorizontalAlignment = 'center';
app.e_cEditFieldLabel.Layout.Row = 4;
app.e_cEditFieldLabel.Layout.Column = 1;
app.e_cEditFieldLabel.Text = 'e_c';


% Create e_cEditField
app.e_cEditField = uieditfield(app.GridLayout3, 'numeric');
app.e_cEditField.HorizontalAlignment = 'center';
app.e_cEditField.Layout.Row = 4;
app.e_cEditField.Layout.Column = 2;
app.e_cEditField.Value = 0.9;
```

```
% Create e_tEditFieldLabel
app.e_tEditFieldLabel = uilabel(app.GridLayout3);
app.e_tEditFieldLabel.HorizontalAlignment = 'center';
app.e_tEditFieldLabel.Layout.Row = 5;
app.e_tEditFieldLabel.Layout.Column = 1;
app.e_tEditFieldLabel.Text = 'e_t';


% Create e_tEditField
app.e_tEditField = uieditfield(app.GridLayout3, 'numeric');
app.e_tEditField.HorizontalAlignment = 'center';
app.e_tEditField.Layout.Row = 5;
app.e_tEditField.Layout.Column = 2;
app.e_tEditField.Value = 0.91;


% Create e_fEditFieldLabel
app.e_fEditFieldLabel = uilabel(app.GridLayout3);
app.e_fEditFieldLabel.HorizontalAlignment = 'center';
app.e_fEditFieldLabel.Layout.Row = 4;
app.e_fEditFieldLabel.Layout.Column = 3;
app.e_fEditFieldLabel.Text = 'e_f';


% Create e_fEditField
app.e_fEditField = uieditfield(app.GridLayout3, 'numeric');
app.e_fEditField.HorizontalAlignment = 'center';
app.e_fEditField.Layout.Row = 4;
app.e_fEditField.Layout.Column = 4;
app.e_fEditField.Value = 0.89;


% Create pi_fnEditFieldLabel
app.pi_fnEditFieldLabel = uilabel(app.GridLayout3);
app.pi_fnEditFieldLabel.HorizontalAlignment = 'center';
app.pi_fnEditFieldLabel.Layout.Row = 3;
app.pi_fnEditFieldLabel.Layout.Column = 3;
app.pi_fnEditFieldLabel.Text = 'pi_fn';


% Create pi_fnEditField
app.pi_fnEditField = uieditfield(app.GridLayout3, 'numeric');
app.pi_fnEditField.HorizontalAlignment = 'center';
app.pi_fnEditField.Layout.Row = 3;
app.pi_fnEditField.Layout.Column = 4;
app.pi_fnEditField.Value = 0.98;


% Create pi_nEditFieldLabel
app.pi_nEditFieldLabel = uilabel(app.GridLayout3);
app.pi_nEditFieldLabel.HorizontalAlignment = 'center';
app.pi_nEditFieldLabel.Layout.Row = 3;
app.pi_nEditFieldLabel.Layout.Column = 1;
app.pi_nEditFieldLabel.Text = 'pi_n';


% Create pi_nEditField
app.pi_nEditField = uieditfield(app.GridLayout3, 'numeric');
app.pi_nEditField.HorizontalAlignment = 'center';
app.pi_nEditField.Layout.Row = 3;
app.pi_nEditField.Layout.Column = 2;
app.pi_nEditField.Value = 0.98;
```

```
            % Create pi_ABEditFieldLabel
            app.pi_ABEditFieldLabel = uilabel(app.GridLayout3);
            app.pi_ABEditFieldLabel.HorizontalAlignment = 'center';
            app.pi_ABEditFieldLabel.Layout.Row = 2;
            app.pi_ABEditFieldLabel.Layout.Column = 1;
            app.pi_ABEditFieldLabel.Text = 'pi_AB';

            % Create pi_ABEditField
            app.pi_ABEditField = uieditfield(app.GridLayout3, 'numeric');
            app.pi_ABEditField.HorizontalAlignment = 'center';
            app.pi_ABEditField.Layout.Row = 2;
            app.pi_ABEditField.Layout.Column = 2;
            app.pi_ABEditField.Value = 0.94;

            % Create CaseSelectionPanel
            app.CaseSelectionPanel = uipanel(app.AfterburnerTurbofan);
            app.CaseSelectionPanel.TitlePosition = 'centertop';
            app.CaseSelectionPanel.Title = 'Case Selection';
            app.CaseSelectionPanel.FontWeight = 'bold';
            app.CaseSelectionPanel.Position = [22 640 263 55];

            % Create CaseDropDownLabel
            app.CaseDropDownLabel = uilabel(app.CaseSelectionPanel);
            app.CaseDropDownLabel.HorizontalAlignment = 'right';
            app.CaseDropDownLabel.Position = [1 9 34 22];
            app.CaseDropDownLabel.Text = 'Case';

            % Create CaseDropDown
            app.CaseDropDown = uidropdown(app.CaseSelectionPanel);
            app.CaseDropDown.Items = {'Single Condition', 'Varying Bypass and pi_f', 
'Varying pi_f and pi_c', 'Varying Bypass and pi_c', 'Varying Mach No and pi_c', 'Varying 
Mach No and Bypass', 'Varying Mach No and pi_f', 'Varying Mach No and T_t4', 'Varying Mach 
No and T_t7', 'Varying Mach No and T_t17'};
            app.CaseDropDown.ValueChangedFcn = createCallbackFcn(app, 
@CaseDropDownValueChanged, true);
            app.CaseDropDown.Position = [49 9 201 22];
            app.CaseDropDown.Value = 'Single Condition';

            % Create DesignChoicesPanel
            app.DesignChoicesPanel = uipanel(app.AfterburnerTurbofan);
            app.DesignChoicesPanel.TitlePosition = 'centertop';
            app.DesignChoicesPanel.Title = 'Design Choices';
            app.DesignChoicesPanel.FontWeight = 'bold';
            app.DesignChoicesPanel.Position = [20 31 265 344];

            % Create GridLayout4
            app.GridLayout4 = uigridlayout(app.DesignChoicesPanel);
            app.GridLayout4.ColumnWidth = {'100x', '100x'};
            app.GridLayout4.RowHeight = {'1x', '1x', '1x', '1x', '1x', '1x', '1x', '1x', 
'1x', '1x', '1x'};

            % Create ComputeButton
            app.ComputeButton = uibutton(app.GridLayout4, 'push');
            app.ComputeButton.ButtonPushedFcn = createCallbackFcn(app, 
@ComputeButtonPushed, true);
            app.ComputeButton.Layout.Row = 11;
            app.ComputeButton.Layout.Column = [1 2];
```

```
app.ComputeButton.Text = 'Compute';

% Create Minpi_cValueLabel
app.Minpi_cValueLabel = uilabel(app.GridLayout4);
app.Minpi_cValueLabel.HorizontalAlignment = 'center';
app.Minpi_cValueLabel.Layout.Row = 1;
app.Minpi_cValueLabel.Layout.Column = 1;
app.Minpi_cValueLabel.Text = 'Min pi_c Value';

% Create Minpi_cValueEditField
app.Minpi_cValueEditField = uieditfield(app.GridLayout4, 'numeric');
app.Minpi_cValueEditField.HorizontalAlignment = 'center';
app.Minpi_cValueEditField.Layout.Row = 1;
app.Minpi_cValueEditField.Layout.Column = 2;
app.Minpi_cValueEditField.Value = 22;

% Create Minpi_fValueEditFieldLabel
app.Minpi_fValueEditFieldLabel = uilabel(app.GridLayout4);
app.Minpi_fValueEditFieldLabel.HorizontalAlignment = 'center';
app.Minpi_fValueEditFieldLabel.Layout.Row = 4;
app.Minpi_fValueEditFieldLabel.Layout.Column = 1;
app.Minpi_fValueEditFieldLabel.Text = 'Min pi_f Value';

% Create Minpi_fEditField
app.Minpi_fEditField = uieditfield(app.GridLayout4, 'numeric');
app.Minpi_fEditField.HorizontalAlignment = 'center';
app.Minpi_fEditField.Layout.Row = 4;
app.Minpi_fEditField.Layout.Column = 2;
app.Minpi_fEditField.Value = 2;

% Create Maxpi_fValueEditFieldLabel
app.Maxpi_fValueEditFieldLabel = uilabel(app.GridLayout4);
app.Maxpi_fValueEditFieldLabel.HorizontalAlignment = 'center';
app.Maxpi_fValueEditFieldLabel.Layout.Row = 6;
app.Maxpi_fValueEditFieldLabel.Layout.Column = 1;
app.Maxpi_fValueEditFieldLabel.Text = 'Max pi_f Value';

% Create Maxpi_fEditField
app.Maxpi_fEditField = uieditfield(app.GridLayout4, 'numeric');
app.Maxpi_fEditField.HorizontalAlignment = 'center';
app.Maxpi_fEditField.Layout.Row = 6;
app.Maxpi_fEditField.Layout.Column = 2;
app.Maxpi_fEditField.Value = 5;

% Create MinByPassRatioValueEditFieldLabel
app.MinByPassRatioValueEditFieldLabel = uilabel(app.GridLayout4);
app.MinByPassRatioValueEditFieldLabel.HorizontalAlignment = 'center';
app.MinByPassRatioValueEditFieldLabel.Layout.Row = 7;
app.MinByPassRatioValueEditFieldLabel.Layout.Column = 1;
app.MinByPassRatioValueEditFieldLabel.Text = 'Min By-Pass Ratio Value';

% Create MinByPassRatioEditField
app.MinByPassRatioEditField = uieditfield(app.GridLayout4, 'numeric');
app.MinByPassRatioEditField.HorizontalAlignment = 'center';
app.MinByPassRatioEditField.Layout.Row = 7;
app.MinByPassRatioEditField.Layout.Column = 2;
```

```
            app.MinByPassRatioEditField.Value = 0.5;

            % Create MaxByPassRatioEditFieldLabel
            app.MaxByPassRatioEditFieldLabel = uilabel(app.GridLayout4);
            app.MaxByPassRatioEditFieldLabel.HorizontalAlignment = 'center';
            app.MaxByPassRatioEditFieldLabel.Layout.Row = 9;
            app.MaxByPassRatioEditFieldLabel.Layout.Column = 1;
            app.MaxByPassRatioEditFieldLabel.Text = 'Max By-Pass Ratio';

            % Create MaxByPassRatioEditField
            app.MaxByPassRatioEditField = uieditfield(app.GridLayout4, 'numeric');
            app.MaxByPassRatioEditField.HorizontalAlignment = 'center';
            app.MaxByPassRatioEditField.Layout.Row = 9;
            app.MaxByPassRatioEditField.Layout.Column = 2;
            app.MaxByPassRatioEditField.Value = 3;

            % Create pi_fIncrementEditFieldLabel
            app.pi_fIncrementEditFieldLabel = uilabel(app.GridLayout4);
            app.pi_fIncrementEditFieldLabel.HorizontalAlignment = 'center';
            app.pi_fIncrementEditFieldLabel.Layout.Row = 5;
            app.pi_fIncrementEditFieldLabel.Layout.Column = 1;
            app.pi_fIncrementEditFieldLabel.Text = 'pi_f Increment';

            % Create pi_fIncrementEditField
            app.pi_fIncrementEditField = uieditfield(app.GridLayout4, 'numeric');
            app.pi_fIncrementEditField.HorizontalAlignment = 'center';
            app.pi_fIncrementEditField.Layout.Row = 5;
            app.pi_fIncrementEditField.Layout.Column = 2;
            app.pi_fIncrementEditField.Value = 0.2;

            % Create ByPassRatioIncrementEditFieldLabel
            app.ByPassRatioIncrementEditFieldLabel = uilabel(app.GridLayout4);
            app.ByPassRatioIncrementEditFieldLabel.HorizontalAlignment = 'center';
            app.ByPassRatioIncrementEditFieldLabel.Layout.Row = 8;
            app.ByPassRatioIncrementEditFieldLabel.Layout.Column = 1;
            app.ByPassRatioIncrementEditFieldLabel.Text = 'By-Pass Ratio Increment';

            % Create ByPassRatioIncrementEditField
            app.ByPassRatioIncrementEditField = uieditfield(app.GridLayout4, 'numeric');
            app.ByPassRatioIncrementEditField.HorizontalAlignment = 'center';
            app.ByPassRatioIncrementEditField.Layout.Row = 8;
            app.ByPassRatioIncrementEditField.Layout.Column = 2;
            app.ByPassRatioIncrementEditField.Value = 0.5;

            % Create pi_cIncrementEditField_2Label
            app.pi_cIncrementEditField_2Label = uilabel(app.GridLayout4);
            app.pi_cIncrementEditField_2Label.HorizontalAlignment = 'center';
            app.pi_cIncrementEditField_2Label.Layout.Row = 2;
            app.pi_cIncrementEditField_2Label.Layout.Column = 1;
            app.pi_cIncrementEditField_2Label.Text = 'pi_c Increment';

            % Create pi_cIncrementEditField
            app.pi_cIncrementEditField = uieditfield(app.GridLayout4, 'numeric');
            app.pi_cIncrementEditField.HorizontalAlignment = 'center';
            app.pi_cIncrementEditField.Layout.Row = 2;
            app.pi_cIncrementEditField.Layout.Column = 2;
```

```
app.pi_cIncrementEditField.Value = 1;


% Create Maxpi_cValueEditField_2Label
app.Maxpi_cValueEditField_2Label = uilabel(app.GridLayout4);
app.Maxpi_cValueEditField_2Label.HorizontalAlignment = 'center';
app.Maxpi_cValueEditField_2Label.Layout.Row = 3;
app.Maxpi_cValueEditField_2Label.Layout.Column = 1;
app.Maxpi_cValueEditField_2Label.Text = 'Max pi_c Value';


% Create Maxpi_cValueEditField
app.Maxpi_cValueEditField = uieditfield(app.GridLayout4, 'numeric');
app.Maxpi_cValueEditField.HorizontalAlignment = 'center';
app.Maxpi_cValueEditField.Layout.Row = 3;
app.Maxpi_cValueEditField.Layout.Column = 2;
app.Maxpi_cValueEditField.Value = 30;


% Create XAxisSwitchLabel
app.XAxisSwitchLabel = uilabel(app.GridLayout4);
app.XAxisSwitchLabel.HorizontalAlignment = 'center';
app.XAxisSwitchLabel.Layout.Row = 10;
app.XAxisSwitchLabel.Layout.Column = 1;
app.XAxisSwitchLabel.Text = 'X Axis';


% Create XAxisSwitch
app.XAxisSwitch = uiswitch(app.GridLayout4, 'slider');
app.XAxisSwitch.Items = {'alpha', 'pi_f'};
app.XAxisSwitch.Layout.Row = 10;
app.XAxisSwitch.Layout.Column = 2;
app.XAxisSwitch.Value = 'alpha';


% Create GasPropertiesPanel
app.GasPropertiesPanel = uipanel(app.AfterburnerTurbofan);
app.GasPropertiesPanel.TitlePosition = 'centertop';
app.GasPropertiesPanel.Title = 'Gas Properties';
app.GasPropertiesPanel.FontWeight = 'bold';
app.GasPropertiesPanel.Position = [500 495 248 200];


% Create GridLayout5
app.GridLayout5 = uigridlayout(app.GasPropertiesPanel);
app.GridLayout5.RowHeight = {'1x', '1x', '1x', '1x', '1x', '1x'};


% Create c_ptkJkgKEditFieldLabel
app.c_ptkJkgKEditFieldLabel = uilabel(app.GridLayout5);
app.c_ptkJkgKEditFieldLabel.HorizontalAlignment = 'center';
app.c_ptkJkgKEditFieldLabel.Layout.Row = 2;
app.c_ptkJkgKEditFieldLabel.Layout.Column = 1;
app.c_ptkJkgKEditFieldLabel.Text = 'c_pt (kJ/(kg.K))';


% Create c_ptkJkgKEditField
app.c_ptkJkgKEditField = uieditfield(app.GridLayout5, 'numeric');
app.c_ptkJkgKEditField.HorizontalAlignment = 'center';
app.c_ptkJkgKEditField.Layout.Row = 2;
app.c_ptkJkgKEditField.Layout.Column = 2;
app.c_ptkJkgKEditField.Value = 1.2351;
```

```
% Create c_pABkJkgKLabel
app.c_pABkJkgKLabel = uilabel(app.GridLayout5);
app.c_pABkJkgKLabel.HorizontalAlignment = 'center';
app.c_pABkJkgKLabel.Layout.Row = 4;
app.c_pABkJkgKLabel.Layout.Column = 1;
app.c_pABkJkgKLabel.Text = 'c_pAB (kJ/(kg.K))';

% Create c_pABkJkgKEditField
app.c_pABkJkgKEditField = uieditfield(app.GridLayout5, 'numeric');
app.c_pABkJkgKEditField.HorizontalAlignment = 'center';
app.c_pABkJkgKEditField.Layout.Row = 4;
app.c_pABkJkgKEditField.Layout.Column = 2;
app.c_pABkJkgKEditField.Value = 1.2351;

% Create c_pDBkJkgKEditFieldLabel
app.c_pDBkJkgKEditFieldLabel = uilabel(app.GridLayout5);
app.c_pDBkJkgKEditFieldLabel.HorizontalAlignment = 'center';
app.c_pDBkJkgKEditFieldLabel.Layout.Row = 6;
app.c_pDBkJkgKEditFieldLabel.Layout.Column = 1;
app.c_pDBkJkgKEditFieldLabel.Text = 'c_pDB (kJ/(kg.K))';

% Create c_pDBkJkgKEditField
app.c_pDBkJkgKEditField = uieditfield(app.GridLayout5, 'numeric');
app.c_pDBkJkgKEditField.HorizontalAlignment = 'center';
app.c_pDBkJkgKEditField.Layout.Row = 6;
app.c_pDBkJkgKEditField.Layout.Column = 2;
app.c_pDBkJkgKEditField.Value = 1.2351;

% Create gamma_ABEditFieldLabel
app.gamma_ABEditFieldLabel = uilabel(app.GridLayout5);
app.gamma_ABEditFieldLabel.HorizontalAlignment = 'center';
app.gamma_ABEditFieldLabel.Layout.Row = 3;
app.gamma_ABEditFieldLabel.Layout.Column = 1;
app.gamma_ABEditFieldLabel.Text = 'gamma_AB';

% Create gamma_ABEditField
app.gamma_ABEditField = uieditfield(app.GridLayout5, 'numeric');
app.gamma_ABEditField.HorizontalAlignment = 'center';
app.gamma_ABEditField.Layout.Row = 3;
app.gamma_ABEditField.Layout.Column = 2;
app.gamma_ABEditField.Value = 1.3;

% Create gamma_tEditFieldLabel
app.gamma_tEditFieldLabel = uilabel(app.GridLayout5);
app.gamma_tEditFieldLabel.HorizontalAlignment = 'center';
app.gamma_tEditFieldLabel.Layout.Row = 1;
app.gamma_tEditFieldLabel.Layout.Column = 1;
app.gamma_tEditFieldLabel.Text = 'gamma_t';

% Create gamma_tEditField
app.gamma_tEditField = uieditfield(app.GridLayout5, 'numeric');
app.gamma_tEditField.HorizontalAlignment = 'center';
app.gamma_tEditField.Layout.Row = 1;
app.gamma_tEditField.Layout.Column = 2;
app.gamma_tEditField.Value = 1.3;
```

```
            % Create gamma_DBEditFieldLabel
            app.gamma_DBEditFieldLabel = uilabel(app.GridLayout5);
            app.gamma_DBEditFieldLabel.HorizontalAlignment = 'center';
            app.gamma_DBEditFieldLabel.Layout.Row = 5;
            app.gamma_DBEditFieldLabel.Layout.Column = 1;
            app.gamma_DBEditFieldLabel.Text = 'gamma_DB';


            % Create gamma_DBEditField
            app.gamma_DBEditField = uieditfield(app.GridLayout5, 'numeric');
            app.gamma_DBEditField.HorizontalAlignment = 'center';
            app.gamma_DBEditField.Layout.Row = 5;
            app.gamma_DBEditField.Layout.Column = 2;
            app.gamma_DBEditField.Value = 1.3;


            % Create FuelPropertiesPanel
            app.FuelPropertiesPanel = uipanel(app.AfterburnerTurbofan);
            app.FuelPropertiesPanel.TitlePosition = 'centertop';
            app.FuelPropertiesPanel.Title = 'Fuel Properties';
            app.FuelPropertiesPanel.FontWeight = 'bold';
            app.FuelPropertiesPanel.Position = [501 429 246 64];


            % Create GridLayout6
            app.GridLayout6 = uigridlayout(app.FuelPropertiesPanel);
            app.GridLayout6.RowHeight = {'1x'};


            % Create h_PRkJkgEditFieldLabel
            app.h_PRkJkgEditFieldLabel = uilabel(app.GridLayout6);
            app.h_PRkJkgEditFieldLabel.HorizontalAlignment = 'center';
            app.h_PRkJkgEditFieldLabel.Layout.Row = 1;
            app.h_PRkJkgEditFieldLabel.Layout.Column = 1;
            app.h_PRkJkgEditFieldLabel.Text = 'h_PR (kJ/kg)';


            % Create h_PRkJkgEditField
            app.h_PRkJkgEditField = uieditfield(app.GridLayout6, 'numeric');
            app.h_PRkJkgEditField.HorizontalAlignment = 'center';
            app.h_PRkJkgEditField.Layout.Row = 1;
            app.h_PRkJkgEditField.Layout.Column = 2;
            app.h_PRkJkgEditField.Value = 42798;


            % Show the figure after all components are created
            app.AfterburnerTurbofan.Visible = 'on';
        end
    end


    % App creation and deletion
    methods (Access = public)


        % Construct app
        function app = SSATFv2_5


            % Create UIFigure and components
            createComponents(app)


            % Register the app with App Designer
```

```
            registerApp(app, app.AfterburnerTurbofan)


            % Execute the startup function
            runStartupFcn(app, @startupFcn)


            if nargout == 0
                clear app
            end
        end


        % Code that executes before app deletion
        function delete(app)


            % Delete UIFigure when app is deleted
            delete(app.AfterburnerTurbofan)
        end
    end
end
```