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# Run Design Set

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This file (RunDesignSet) illustrates how to calculate mission parameters (mass, fuel and range) for a set of design missions defined by a target payload, target range and aircraft parameters. The climb performance parameters are also calculated.

The main file for running the Design Case is **FindDesignPoint** For brief description type: *help FindDesignPoint*

Created by: D Rezgui, S Mitchell and M Gibbons Copyright: University of Bristol

## Initialise aircraft parameters

```
delete Par; clear Par

clear; clc
disp(' ')
disp('          ***** Aircraft Performance Tool *****');
disp('          ***** Run Design Mission Case *****')
disp(['          ', datestr(clock)]);
disp(' ')

% Read Aircraft data from a re-defined file, e.g. 'AC_B777_AJenk' or
'AC_150C_twin'
ParFunc = 'AC_B777_AJenk'; % or ParFunc = 'AC_150C_twin';
Par      = eval(ParFunc);  % Set parameters in the "Par" object,
                          % Default values are set in the ParFunc

disp(['... Aircraft parameters are set, based on ', ParFunc, ' data
file'])
disp(' ')

% Reset parameters from default values (other parameters can be
changed in
% the Par object)
Par.PL_req    = 29050; % Required payload mass [kg]
Par.Range_req = 4779; % Required design range [nm]

% You can also reset the following parameters. (you can also change
these parameters in the ParFunc file)
% Par.S              = 376.4;          % Wing area [m^2]
```

```
% Par.PLmax           = 45000;      % Max payload [kg]
% Par.MFC             = 80000;      % Max Fuel capacity [kg]
% Par.MTOM            = 230000;     % Max Take Off Mass [kg]
% Par.Airframe         = 130000;     % Operating Mass Empty [kg]
% Par.Alt_Cruise      = 35000;      % Cruise Alt [ft]
% Par.DragRise         = 0;          % Flag to switch drag rise in the drag
% polar: 1 = Yes, 0 = No

% Reset engine data parameters (if needed)
Par.interp_method = 'linear'; % or 'spline' - 'spline' is slower but
% allows to extrapolate data
Par.M_ext = []; % Extend Mach number range to M_ext - change to
% something like 0.1 if needed

***** Aircraft Performance Tool *****
***** Run Design Mission Case *****
20-Feb-2017 13:57:33

... Aircraft parameters are set, based on AC_B777_AJenk data file
```

## Calculate the mass, fuel and range for a set of missions

Find mission properties for a set of Mach numbers

```
% Define a set of cruise numbers
par_set = 0.78:0.01:0.84; % Define an appropriate parameter range
xlabel = 'Mach Number [-]'; % Define a label for the parameter used for
% the parameter set

% Find results for the first design point (i=1)
i = 1;
disp(['Start calculations for design point number: ' num2str(i) '
value: ' num2str(par_set(i))]);
% Set target design range. All other parameters are unchanged
Par.Mach_Cruise = par_set(i); % Required design range [nm].
% call function FindDesignPoint to calculate mission properties
dp1(i) = FindDesignPoint(Par);

% Start loop for the rest of the design points
if length(par_set)>1
    for i=2:length(par_set)
        disp(['Start calculations for design point number: ' num2str(i) '
value: ' num2str(par_set(i))]);
        % Set target design range. All other parameters are unchanged
        Par.Mach_Cruise = par_set(i); % Required design range [nm].
        % call function FindDesignPoint to calculate mission properties
        dp1(i) = FindDesignPoint(Par, dp1(1).EngineData, dp1(1).TOM_design);
    end
else
    disp(' ');
end
```

```
warning(' ... There is only one design point in this parameter  
set');  
disp(' ');  
end
```

Start calculations for design point number: 1 value: 0.78

... Engine data prepared from UBB65Data

... Calculating the value of aircraft Take-Off Mass (TOM) for the  
required design case

Payload required : 29050 kg  
Range required : 4779 nm  
Cruise altitude : 35000 ft  
Cruise Mach No. : 0.78

..... Done  
Elapsed time is 11.533302 seconds.

Calculate fuel burn for the required design case

.... Done  
Elapsed time is 0.363966 seconds.

TOM for required the mission : 220279 kg  
Block time for the mission : 665 minutes  
Block fuel for the mission : 53424 kg  
Reserve fuel for the mission : 8603 kg  
Total fuel for the mission : 61874 kg

Start calculations for design point number: 2 value: 0.79

... Calculating the value of aircraft Take-Off Mass (TOM) for the  
required design case

Payload required : 29050 kg  
Range required : 4779 nm  
Cruise altitude : 35000 ft  
Cruise Mach No. : 0.79

..... Done  
Elapsed time is 5.626772 seconds.

Calculate fuel burn for the required design case

.... Done  
Elapsed time is 0.307678 seconds.

TOM for required the mission : 220198 kg  
Block time for the mission : 657 minutes  
Block fuel for the mission : 53299 kg  
Reserve fuel for the mission : 8647 kg  
Total fuel for the mission : 61794 kg

Start calculations for design point number: 3 value: 0.8

... Calculating the value of aircraft Take-Off Mass (TOM) for the  
required design case

Payload required : 29050 kg

Range required : 4779 nm  
Cruise altitude : 35000 ft  
Cruise Mach No. : 0.8

..... Done  
Elapsed time is 5.385789 seconds.

Calculate fuel burn for the required design case  
.... Done  
Elapsed time is 0.338915 seconds.

TOM for required the mission : 220169 kg  
Block time for the mission : 650 minutes  
Block fuel for the mission : 53225 kg  
Reserve fuel for the mission : 8693 kg  
Total fuel for the mission : 61765 kg

Start calculations for design point number: 4 value: 0.81  
... Calculating the value of aircraft Take-Off Mass (TOM) for the  
required design case  
Payload required : 29050 kg  
Range required : 4779 nm  
Cruise altitude : 35000 ft  
Cruise Mach No. : 0.81

..... Done  
Elapsed time is 5.390560 seconds.

Calculate fuel burn for the required design case  
.... Done  
Elapsed time is 0.356936 seconds.

TOM for required the mission : 220183 kg  
Block time for the mission : 643 minutes  
Block fuel for the mission : 53191 kg  
Reserve fuel for the mission : 8741 kg  
Total fuel for the mission : 61779 kg

Start calculations for design point number: 5 value: 0.82  
... Calculating the value of aircraft Take-Off Mass (TOM) for the  
required design case  
Payload required : 29050 kg  
Range required : 4779 nm  
Cruise altitude : 35000 ft  
Cruise Mach No. : 0.82

..... Done  
Elapsed time is 4.693198 seconds.

Calculate fuel burn for the required design case  
.... Done  
Elapsed time is 0.310324 seconds.

TOM for required the mission : 220234 kg

Block time for the mission : 636 minutes  
Block fuel for the mission : 53193 kg  
Reserve fuel for the mission : 8790 kg  
Total fuel for the mission : 61830 kg

Start calculations for design point number: 6 value: 0.83  
... Calculating the value of aircraft Take-Off Mass (TOM) for the  
required design case  
Payload required : 29050 kg  
Range required : 4779 nm  
Cruise altitude : 35000 ft  
Cruise Mach No. : 0.83

..... Done  
Elapsed time is 4.815781 seconds.

Calculate fuel burn for the required design case  
.... Done  
Elapsed time is 0.318992 seconds.

TOM for required the mission : 220330 kg  
Block time for the mission : 629 minutes  
Block fuel for the mission : 53237 kg  
Reserve fuel for the mission : 8841 kg  
Total fuel for the mission : 61926 kg

Start calculations for design point number: 7 value: 0.84  
... Calculating the value of aircraft Take-Off Mass (TOM) for the  
required design case  
Payload required : 29050 kg  
Range required : 4779 nm  
Cruise altitude : 35000 ft  
Cruise Mach No. : 0.84

..... Done  
Elapsed time is 6.053501 seconds.

Calculate fuel burn for the required design case  
.... Done  
Elapsed time is 0.326247 seconds.

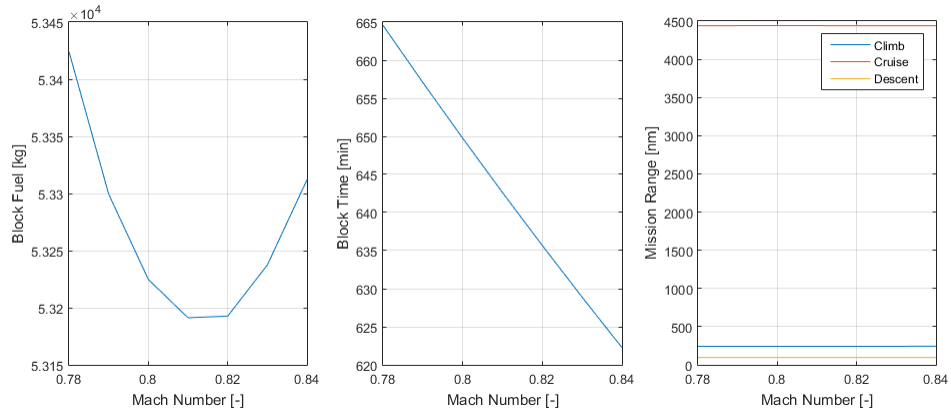
TOM for required the mission : 220459 kg  
Block time for the mission : 622 minutes  
Block fuel for the mission : 53312 kg  
Reserve fuel for the mission : 8895 kg  
Total fuel for the mission : 62054 kg

## Plot Mission Profile

Call plotter Design Set

PlotDSet(dp1,par\_set,xlab)

drawnow



## Repeat Design Set calculations but with drag rise corrections

Calculate the mass, fuel and range for a set of missions Find mission properties for a set of Mack numbers

```

Par.DragRise = 1;           % Flag to switch drag rise in the drag polar: 1
                             = Yes, 0 = No

% Find results for the first design point (i=1)
i = 1;
disp(['Start calculations for design point number: ' num2str(i) '
value: ' num2str(par_set(i))]);
% Set target design range. All other parameters are unchanged
Par.Mach_Cruise = par_set(i); % Required design range [nm].
% call function FindDesignPoint to calculate mission properties
dp2(i) = FindDesignPoint(Par);

% Start loop for the rest of the design points
if length(par_set)>1
    for i=2:length(par_set)
        disp(['Start calculations for design point number: ' num2str(i) '
value: ' num2str(par_set(i))]);
        % Set target design range. All other parameters are unchanged
        Par.Mach_Cruise = par_set(i); % Required design range [nm].
        % call function FindDesignPoint to calculate mission properties
        dp2(i) = FindDesignPoint(Par, dp2(1).EngineData, dp2(1).TOM_design);
    end
else
    disp(' ');
    warning(' ... There is only one design point in this parameter
set');
    disp(' ');
end

```

*Start calculations for design point number: 1 value: 0.78*

... Engine data prepared from UBB65Data

... Calculating the value of aircraft Take-Off Mass (TOM) for the required design case

Payload required : 29050 kg  
Range required : 4779 nm  
Cruise altitude : 35000 ft  
Cruise Mach No. : 0.78

..... Done  
Elapsed time is 27.084631 seconds.

Calculate fuel burn for the required design case

.... Done  
Elapsed time is 0.905407 seconds.

TOM for required the mission : 220279 kg  
Block time for the mission : 665 minutes  
Block fuel for the mission : 53424 kg  
Reserve fuel for the mission : 8603 kg  
Total fuel for the mission : 61874 kg

Start calculations for design point number: 2 value: 0.79

... Calculating the value of aircraft Take-Off Mass (TOM) for the required design case

Payload required : 29050 kg  
Range required : 4779 nm  
Cruise altitude : 35000 ft  
Cruise Mach No. : 0.79

..... Done  
Elapsed time is 14.470892 seconds.

Calculate fuel burn for the required design case

.... Done  
Elapsed time is 0.894067 seconds.

TOM for required the mission : 220198 kg  
Block time for the mission : 657 minutes  
Block fuel for the mission : 53300 kg  
Reserve fuel for the mission : 8647 kg  
Total fuel for the mission : 61794 kg

Start calculations for design point number: 3 value: 0.8

... Calculating the value of aircraft Take-Off Mass (TOM) for the required design case

Payload required : 29050 kg  
Range required : 4779 nm  
Cruise altitude : 35000 ft  
Cruise Mach No. : 0.8

..... Done  
Elapsed time is 15.140488 seconds.

Calculate fuel burn for the required design case  
.... Done  
Elapsed time is 0.934566 seconds.

TOM for required the mission : 220169 kg  
Block time for the mission : 650 minutes  
Block fuel for the mission : 53225 kg  
Reserve fuel for the mission : 8693 kg  
Total fuel for the mission : 61765 kg

Start calculations for design point number: 4 value: 0.81  
... Calculating the value of aircraft Take-Off Mass (TOM) for the  
required design case  
Payload required : 29050 kg  
Range required : 4779 nm  
Cruise altitude : 35000 ft  
Cruise Mach No. : 0.81

..... Done  
Elapsed time is 16.936564 seconds.

Calculate fuel burn for the required design case  
.... Done  
Elapsed time is 0.862957 seconds.

TOM for required the mission : 220183 kg  
Block time for the mission : 643 minutes  
Block fuel for the mission : 53191 kg  
Reserve fuel for the mission : 8741 kg  
Total fuel for the mission : 61779 kg

Start calculations for design point number: 5 value: 0.82  
... Calculating the value of aircraft Take-Off Mass (TOM) for the  
required design case  
Payload required : 29050 kg  
Range required : 4779 nm  
Cruise altitude : 35000 ft  
Cruise Mach No. : 0.82

..... Done  
Elapsed time is 12.904886 seconds.

Calculate fuel burn for the required design case  
.... Done  
Elapsed time is 0.954059 seconds.

TOM for required the mission : 220234 kg  
Block time for the mission : 636 minutes  
Block fuel for the mission : 53193 kg  
Reserve fuel for the mission : 8790 kg  
Total fuel for the mission : 61830 kg

Start calculations for design point number: 6 value: 0.83



```
... Calculating the value of aircraft Take-Off Mass (TOM) for the
  required design case
Payload required : 29050 kg
Range required   : 4779 nm
Cruise altitude  : 35000 ft
Cruise Mach No. : 0.83
```

```
..... Done
Elapsed time is 15.039364 seconds.
```

```
Calculate fuel burn for the required design case
.... Done
Elapsed time is 0.890153 seconds.
```

```
TOM for required the mission : 220410 kg
Block time for the mission   : 629 minutes
Block fuel for the mission   : 53317 kg
Reserve fuel for the mission : 8841 kg
Total fuel for the mission   : 62005 kg
```

```
Start calculations for design point number: 7 value: 0.84
... Calculating the value of aircraft Take-Off Mass (TOM) for the
  required design case
Payload required : 29050 kg
Range required   : 4779 nm
Cruise altitude  : 35000 ft
Cruise Mach No. : 0.84
```

```
..... Done
Elapsed time is 16.942993 seconds.
```

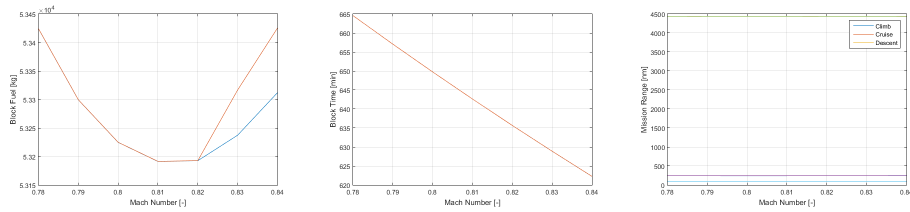
```
Calculate fuel burn for the required design case
.... Done
Elapsed time is 0.863520 seconds.
```

```
TOM for required the mission : 220572 kg
Block time for the mission   : 622 minutes
Block fuel for the mission   : 53425 kg
Reserve fuel for the mission : 8895 kg
Total fuel for the mission   : 62168 kg
```

## Plot Mission Profile

Call plotter Design Set

```
PlotDSet(dp2,par_set,xlab)
```



## Save results

```
savefile = 'DSet1.mat';
save(savefile, 'dp1', 'dp2', 'par_set', 'xlab');
```

## Load saved data to workspace

```
delete Par;
clear % clear workspace
load 'DSet1.mat';
whos % show available variables in the workspace
```

Warning: File 'Par' not found.

| Name    | Size | Bytes  | Class       | Attributes |
|---------|------|--------|-------------|------------|
| dp1     | 1x7  | 425942 | designpoint |            |
| dp2     | 1x7  | 425942 | designpoint |            |
| par_set | 1x7  | 56     | double      |            |
| xlab    | 1x15 | 30     | char        |            |

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