Aircraft Design Project
Urban Air Mobility (UAM)

Week 5
29/11 – 3/12

Instituto Superior Técnico
Universidade de Lisboa

Design Point/MTOW/Wing & tail design
Objectives

Iterate over mass_analysis and design_space_analysis

Explore your design space by modifying important variables in your JSON file:

- Payload/structural mass
- Energy density of batteries
- Velocities
- Radius of rotor blades
- Wing span
- Segment altitudes

Select airfoils for wing, horizontal and vertical stabilizers; refined wing design

- Wing airfoil selection: follow the process described in the "Lecture 7 – Airfoil Selection (Annotated Notes)"
- Vertical/horizontal stabilizers: select appropriate volume coefficients

Wing & tail design
MATLAB implementation

You will be modifying the following variables of the JSON file:

```
{
    "name": "Main Wing",
    "type": "wing.main",
    "interf_factor": 1.0,
    "aspect_ratio": 7.0,
    "mean_chord": 2.3,
    "oswald_efficiency": 0.85,
    "airfoil": {
        "type": "naca0012",
        "tc_max": 0.15,
        "xc_max": 0.3,
        "lift_slope_coefficient": 6.2,
        "cl_max": 2.0
    },
    "sweep_le": 10.0,
    "sweep_c4": 15.0,
    "sweep_tc_max": 20.0,
    "mass": 200
},
```

```
{
    "name": "Horizontal Tail",
    "type": "wing.htail",
    "interf_factor": 1.0,
    "aspect_ratio": 5.0,
    "mean_chord": 0.5,
    "oswald_efficiency": 0.85,
    "airfoil": {
        "type": "naca0012",
        "tc_max": 0.15,
        "xc_max": 0.3,
        "lift_slope_coefficient": 6.2,
        "cl_max": 2.0
    },
    "sweep_le": 10.0,
    "sweep_c4": 15.0,
    "sweep_tc_max": 20.0,
    "mass": 50
},
```

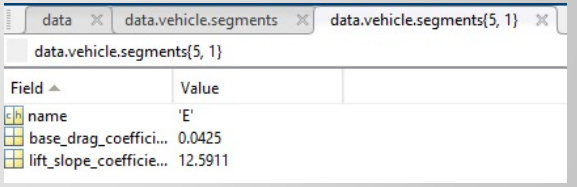
```
{
    "name": "Vertical Tail",
    "type": "wing.vtail",
    "interf_factor": 1.0,
    "aspect_ratio": 5.0,
    "mean_chord": 1.0,
    "oswald_efficiency": 0.85,
    "airfoil": {
        "type": "naca0012",
        "tc_max": 0.15,
        "xc_max": 0.3,
        "lift_slope_coefficient": 6.2,
        "cl_max": 2.0
    },
    "sweep_le": 10.0,
    "sweep_c4": 15.0,
    "sweep_tc_max": 20.0,
    "mass": 50
},
```

You will be running the following MATLAB function:

```
data.vehicle = aero_analysis(data.mission, data.vehicle);
```

Your output will consist of:

- Total $C_{L\alpha}$ for each segment due to all lifting surfaces,
- Total C_{D0} for each segment due to all aircraft components.



Perform, at least, one iteration using the new geometry by running *mass_analysis* and *design_space_analysis*.