

AIRCRAFT PHYSICS



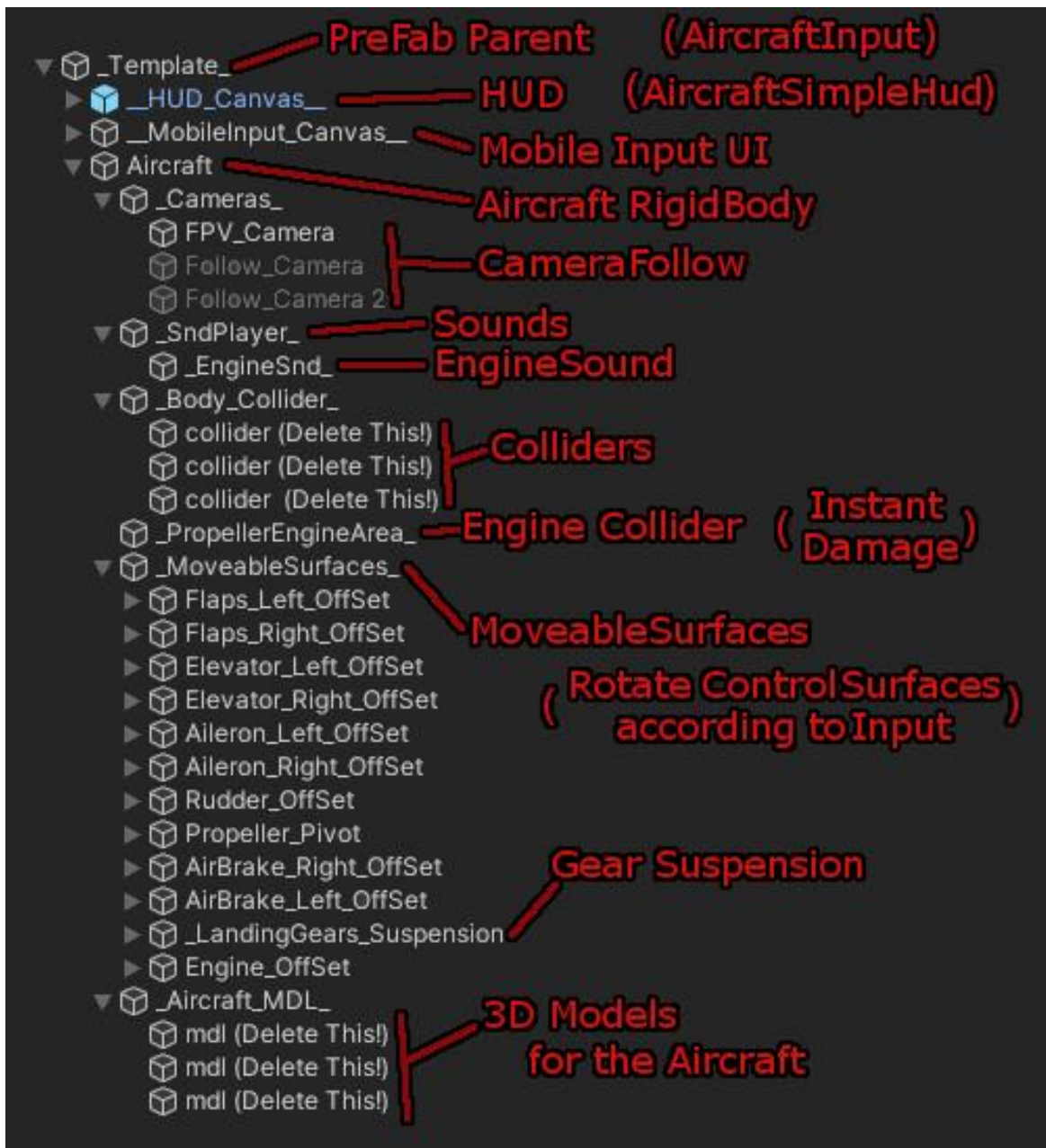
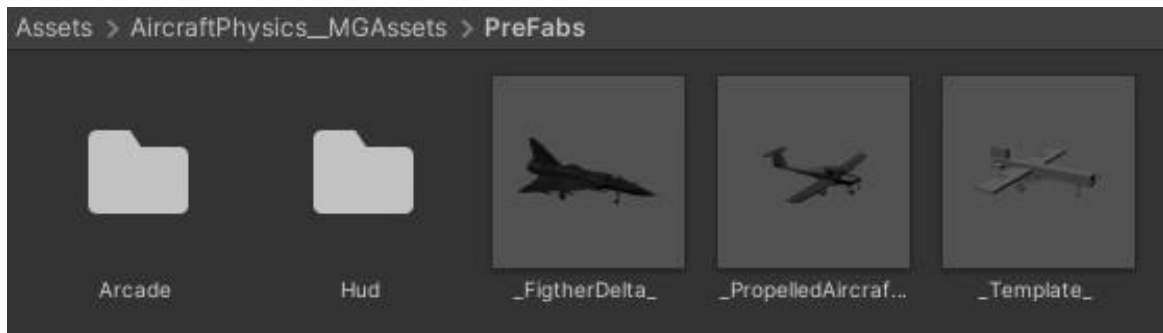
AIRCRAFT PHYSICS

Quick Reference Guide

v 1.0

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- **Contact:** Maloke7-Games@yahoo.com.br
 - **AssetStore:** <https://assetstore.unity.com/publishers/26634>
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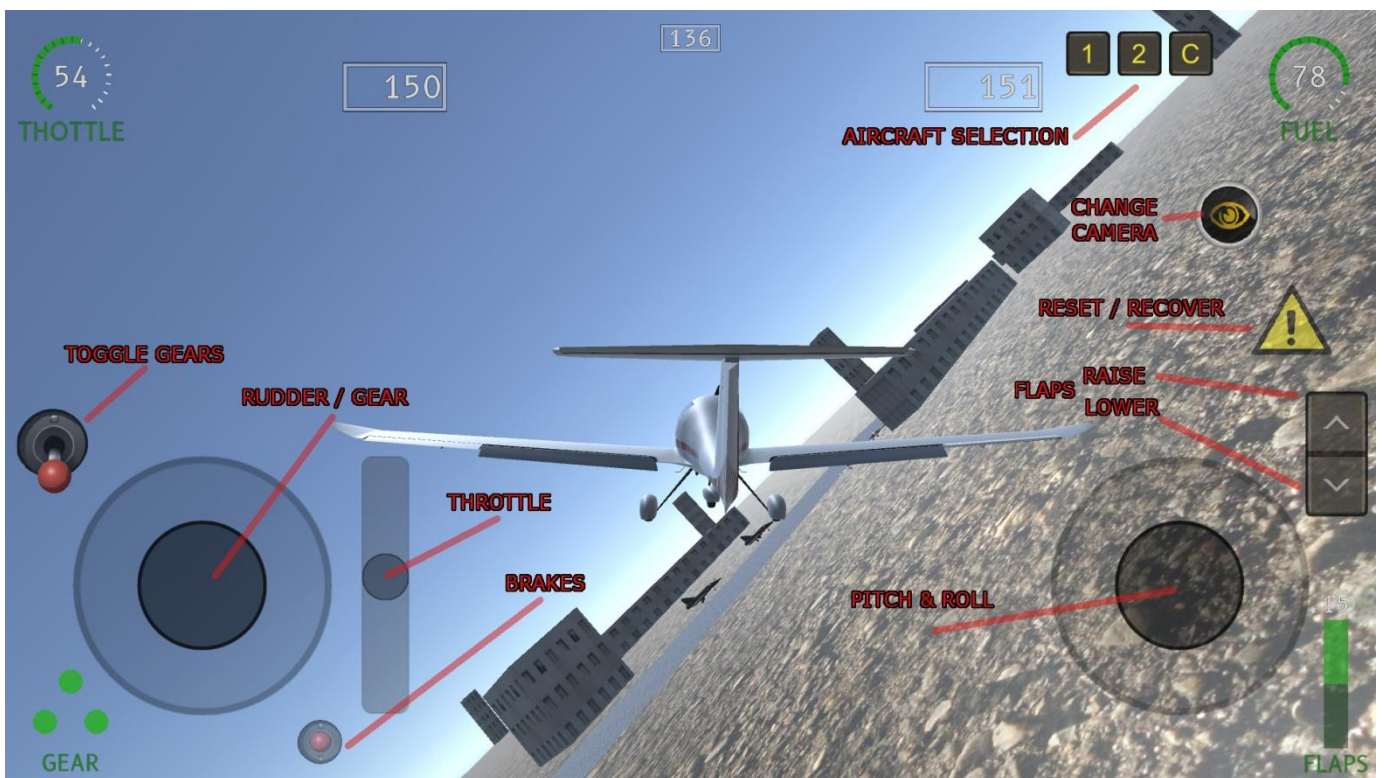
➤ **PreFab Structure:**



➤ Instruments Symbology:



➤ Mobile Input GUI:



➤ Aircraft Script - Behaviour Customization:



General Flight Settings

Pitch Factor	2.5
Roll Factor	2.5
Yaw Factor	2.5
Thrust Factor	2
Throttle Response Factor	0.1
Wing Lift Factor	0.5
Max G	4
Min G	-2
Max Speed	50
Stall Speed	10
Max Altitude	9999
Zero Altitude	0
Ground Height	1.3

Advanced Settings

Use AOA	<input checked="" type="checkbox"/>
Max AOA	30
Wing Alpha	5
Pitch AOA Factor	0.05
Use Stall	<input checked="" type="checkbox"/>
Max AOA Stall	30
Stall Factor	0.1
Stall Lift Factor	0.5
Stall Damp	0.5
Stall Alert	5
Use Fin	<input checked="" type="checkbox"/>
Fin Factor	0.1
Fin Damp	1
Fin Min Vel	3
Drag Factor AOA	10
Altitude Drag Factor	0.1
Damage Drag	0.25
Min Drag	0.01
Max Drag	1

Center of Gravity

CG	X	0	Y	-0.3	Z	0.5
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Each variable has inspector tooltips explanations. Here you will find an overall explanation of how they affect flight behavior according to the desired aircraft class.

--- General Settings ---

- **Pitch, Roll and Yaw Factors** affect the intensity of the torque forces which rotates the aircraft in each axis. A Cargo/Airliner will have values ~1, while a Fighter/Acrobat will have higher around ~3.

- **ThrustFactor** is the Thrust/Weight ratio, higher values mean stronger engines or lighter aircraft. Fighters usually have factors of 0.7~1.0 or slightly above, while others have around ~0.5 or even less like Cargo/Airliner ~0.3. Values higher than 1 will make the aircraft fly vertically like a rocket (Depending also on Drag values).

- **WingLift** affects how sharp the aircraft can make turns (<1 for realistic), and how slow it can fly. Max and Min G clamps the maneuverability. **StallSpeed** is the minimum speed for stability before *stalling* and will roughly correspond to the minimum *TakeOff speed*, depending also on the combinations of the other factors.

- **MaxSpeed** is the maximum theoretical speed the aircraft can reach in ideal conditions. Final speed depend also on the combinations of Drag, Altitude Drag, Flaps Drag, and Angle of Attack.

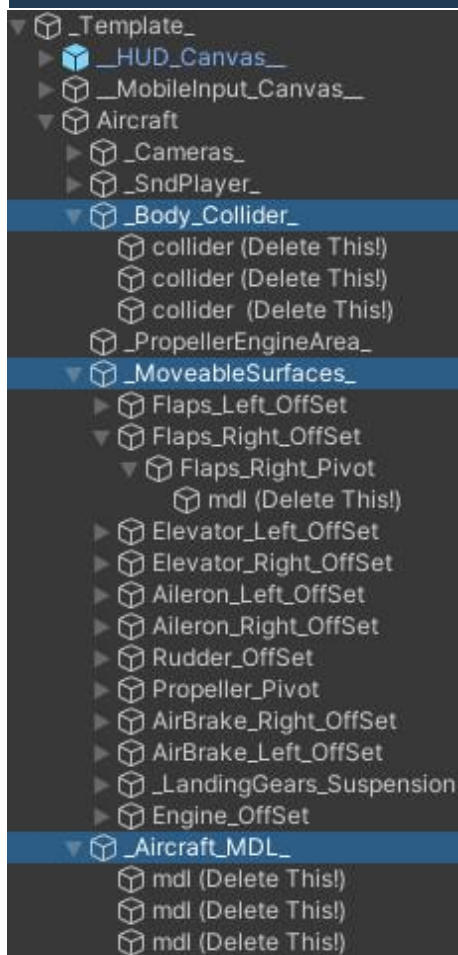
--- Advanced Settings ---

- **MaxAOA** is the *AngleOfAttack* in which the **WingLift** is maximum. **MaxAOAStall** is the AOA in which the wing will stall, decreasing the lift force to the **StallLiftFactor** proportion. The **DragFactorAOA** affects how much speed the aircraft will lose with sharp maneuvers. These values depends on each aircraft's behavior and are not dependent exclusively on the aircraft class, so adjust it based on technical data from the real aircraft or as you feel it needs adjustment.

- **FinFactor** determines the intensity of the fixed rudder/fin forces in aligning the aircraft along the forward speed axis. Lower **FinMinVel** values will force a perfect alignment, while higher values will allow the aircraft to fly sideways at lower speeds.

➤ Quick Steps Replacing the 3D Template Model with a Custom one:

The colliders, Rigidbody, 3D Model, and Control Surfaces are each located nested within different GameObjects used as structure inside the Template Prefab. Let's configure each one individually:

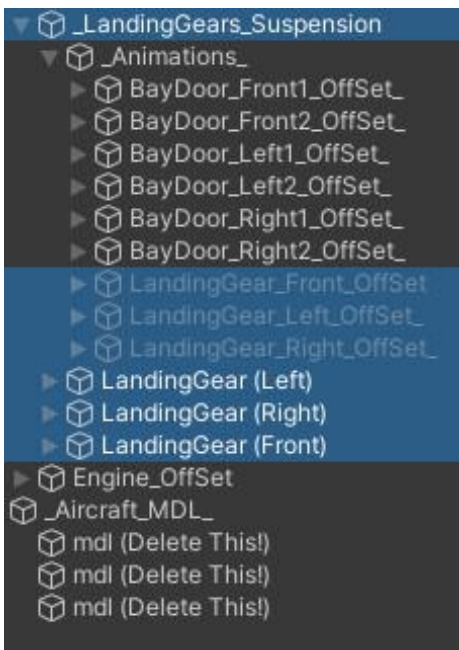


1 - Insert your new 3D model inside the **_Aircraft_MDL_** GameObject. You can delete the Template's mdl's at each step.

2 - Move the new model so that the rear landing gears align with the template's landing gears along the transversal axis (x).

3 - Now move the template's landing gears along the X-axis to match the new model's gear position. **Important!** When moving the template landing gear, make sure to move together the corresponding **LandingGear_xxx_Offset** GameObject located under **_Animations_** GameObject, so that the animations automatically align correctly (see the image on the next page for reference).

4 - If your new model has the control surfaces separated as different GameObjects, then you can animate them. For that, locate each **xxx_Offset** GameObject under the **_MoveableSurfaces_** and align them with your aircraft's pivot point for each control surface. After that, remove the control surface model from the **_Aircraft_MDL_** and nest it inside their corresponding **xxx_Pivot** GameObject. **Important!** Do not move the GameObjects **xxx_Pivot**, they must always be at zero local position and rotation, only the **xxx_Offset** objects must be moved to align with the new model.



5 - Create all the collider components under the **_Body_Collider_** GameObject that you desire to be used in collisions. The collider under the **_PropellerEngineArea_** is a Trigger responsible for instant damage if it enters in contact with anything. Disable this GameObject if you do not wish this feature to work. Consider changing it's Layer in case you have multiple Triggers involving your aircraft to avoid accidental damage triggers.

6 - Adjust the Center of Gravity if necessary. **Attention to the CG position!** It should be located slightly forward from the rear landing gear. If it's located too much forward the aircraft will not be able to take off (will require a big deflection on the gear suspension or an excessive lift and pitchFactor) and if it's located exactly over the landing gear axis or after it, the aircraft will become unstable and could tip backward hitting its tail on the ground and damaging the engine. It's suggested that you position your new 3D model aligning its rear landing gear with the Template's rear landing gear, maintaining the same CG, and

adjusting only the vertical component and the position of the other elements, including the front gear. But of course, you can play engineer and iterate multiple times to achieve a perfect result If you wish for a challenge!

7 - Now adjust the **GroundHeight** value so the script can correctly understand if the aircraft is flying or not. The best way to do it is during play time. Put your aircraft on a flat and stable surface, then increase slowly the GroundHeight value until you see the Status indicating that it **isGrounded**. Use that value for the GroundHeight. You can also see a yellow Gizmo in the scene view.

8 - Test your aircraft and adjust the **General and Advanced Flight Settings** as you wish it to behave, enjoy!