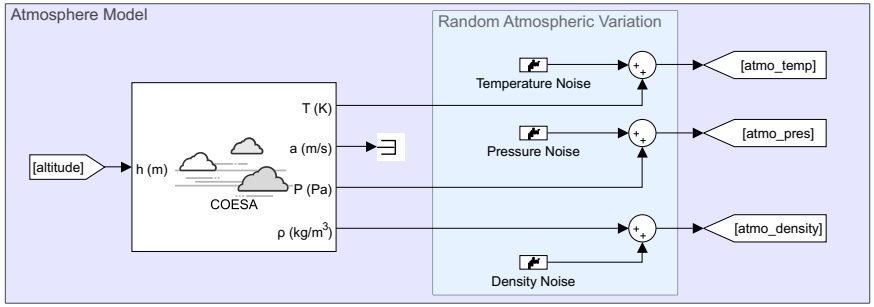
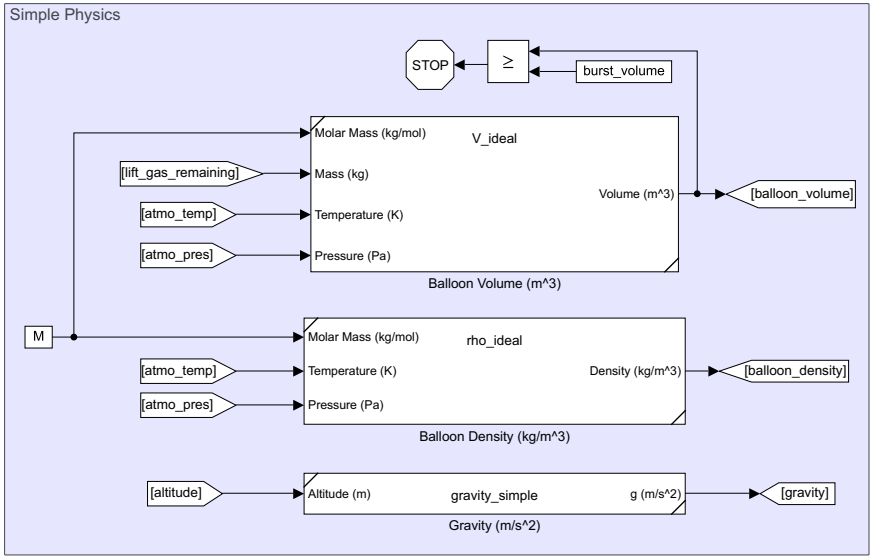
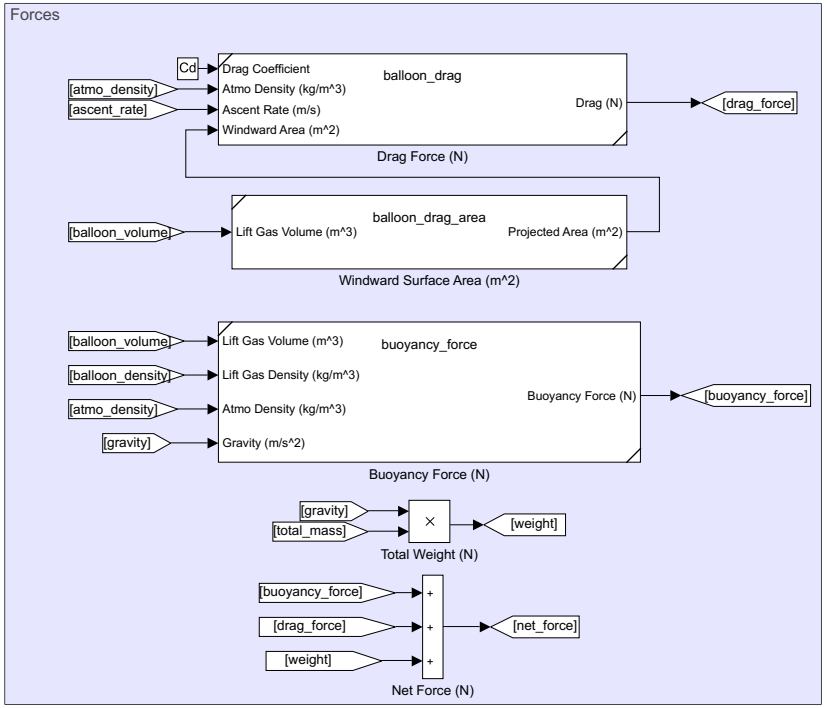
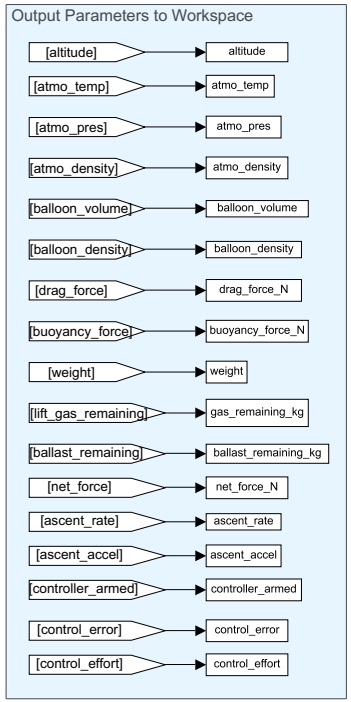
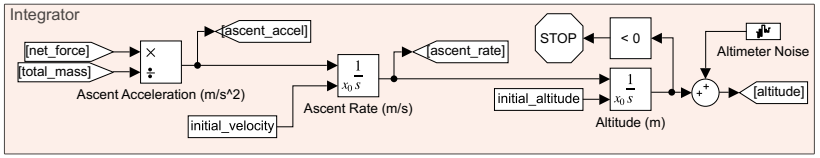
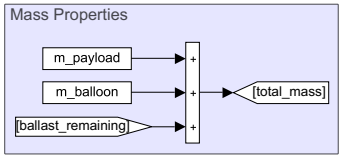

Atmosphere Model
Random Atmospheric Variation
[altitude]
h (m)
COESA
T (K)
a (m/s)
P (Pa)
ρ (kg/m^3)
Temperature Noise
Pressure Noise
Density Noise
[atmo_temp]
[atmo_pres]
[atmo_density]

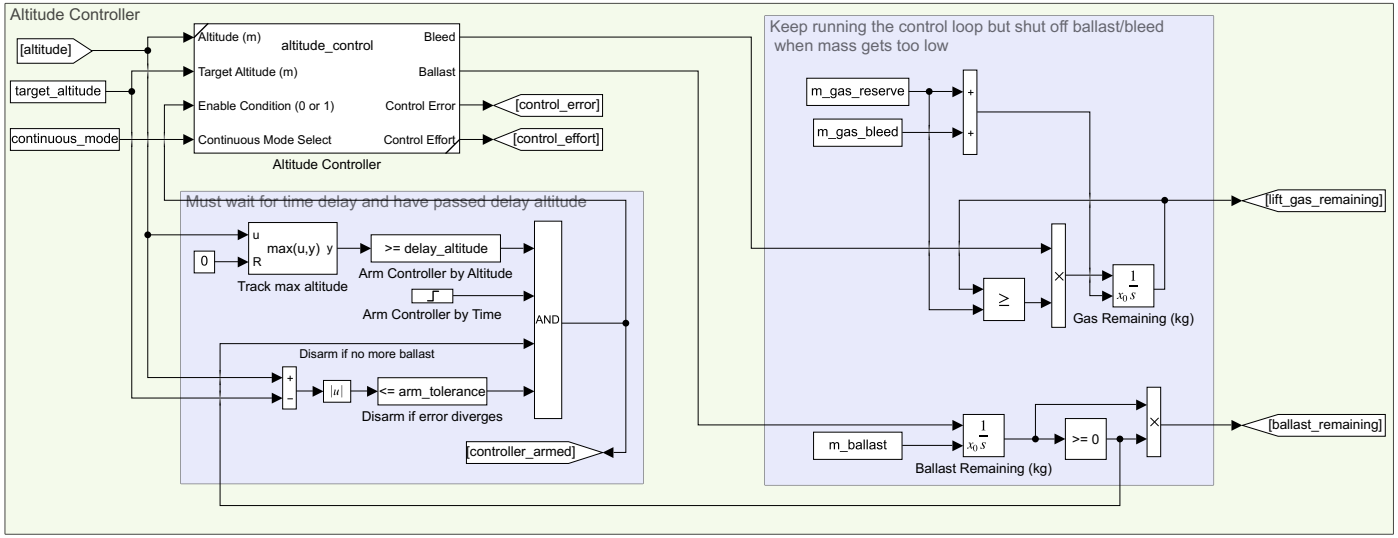

Simple Physics
STOP
≥
burst_volume
Molar Mass (kg/mol)
V_ideal
[lift_gas_remaining]
Mass (kg)
[atmo_temp]
Temperature (K)
[atmo_pres]
Pressure (Pa)
Volume (m^3)
[balloon_volume]
Balloon Volume (m^3)
M
Molar Mass (kg/mol)
rho_ideal
[atmo_temp]
Temperature (K)
[atmo_pres]
Pressure (Pa)
Density (kg/m^3)
[balloon_density]
Balloon Density (kg/m^3)
[altitude]
Altitude (m)
gravity_simple
g (m/s^2)
[gravity]
Gravity (m/s^2)

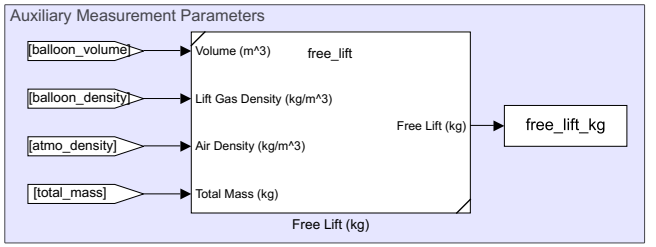

Forces
Cd
Drag Coefficient
[atmo_density]
Atmo Density (kg/m^3)
[ascent_rate]
Ascent Rate (m/s)
Windward Area (m^2)
balloon_drag
Drag (N)
[drag_force]
Drag Force (N)
[balloon_volume]
Lift Gas Volume (m^3)
balloon_drag_area
Projected Area (m^2)
Windward Surface Area (m^2)
[balloon_volume]
[balloon_density]
[atmo_density]
[gravity]
Lift Gas Volume (m^3)
Lift Gas Density (kg/m^3)
Atmo Density (kg/m^3)
Gravity (m/s^2)
buoyancy_force
Buoyancy Force (N)
[buoyancy_force]
Buoyancy Force (N)
[gravity]
[total_mass]
×
[weight]
Total Weight (N)
[buoyancy_force]
[drag_force]
[weight]
[net_force]
Net Force (N)

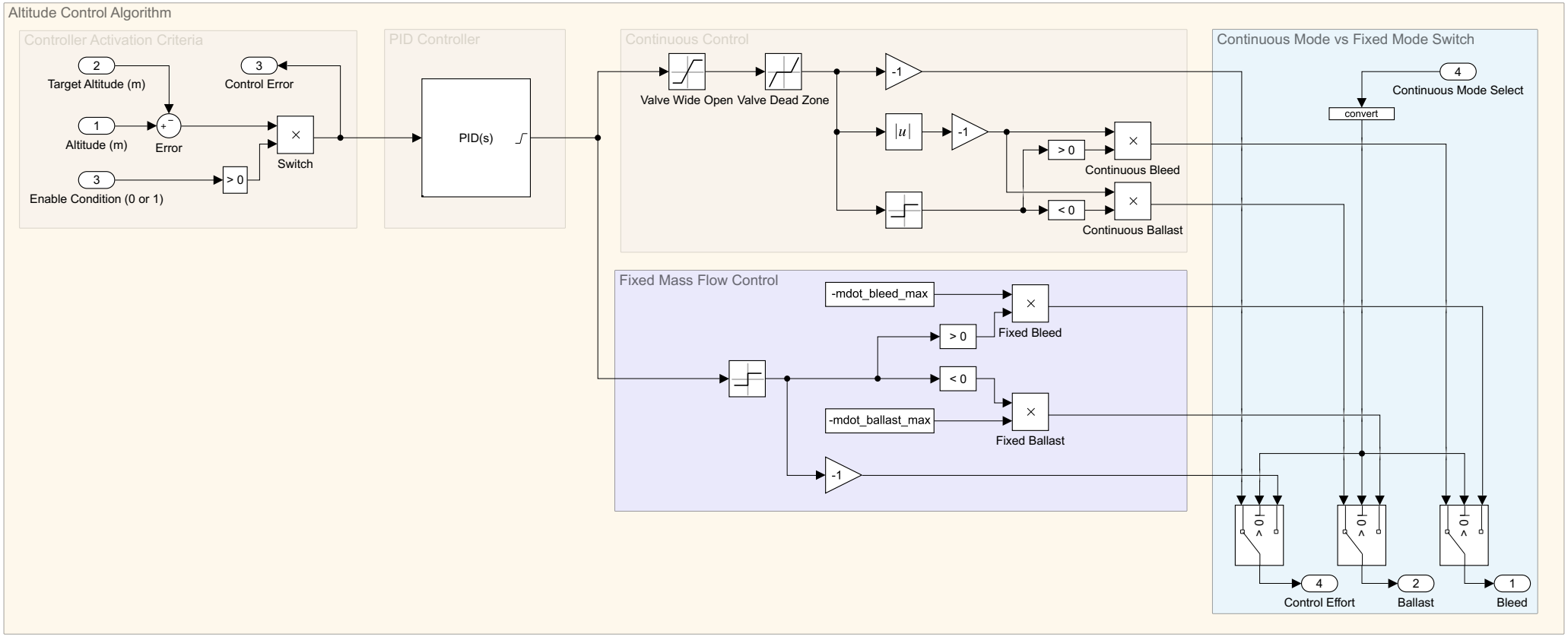

Output Parameters to Workspace
[altitude]
altitude
[atmo_temp]
atmo_temp
[atmo_pres]
atmo_pres
[atmo_density]
atmo_density
[balloon_volume]
balloon_volume
[balloon_density]
balloon_density
[drag_force]
drag_force_N
[buoyancy_force]
buoyancy_force_N
[weight]
weight
[lift_gas_remaining]
gas_remaining_kg
[ballast_remaining]
ballast_remaining_kg
[net_force]
net_force_N
[ascent_rate]
ascent_rate
[ascent_accel]
ascent_accel
[controller_armed]
controller_armed
[control_error]
control_error
[control_effort]
control_effort

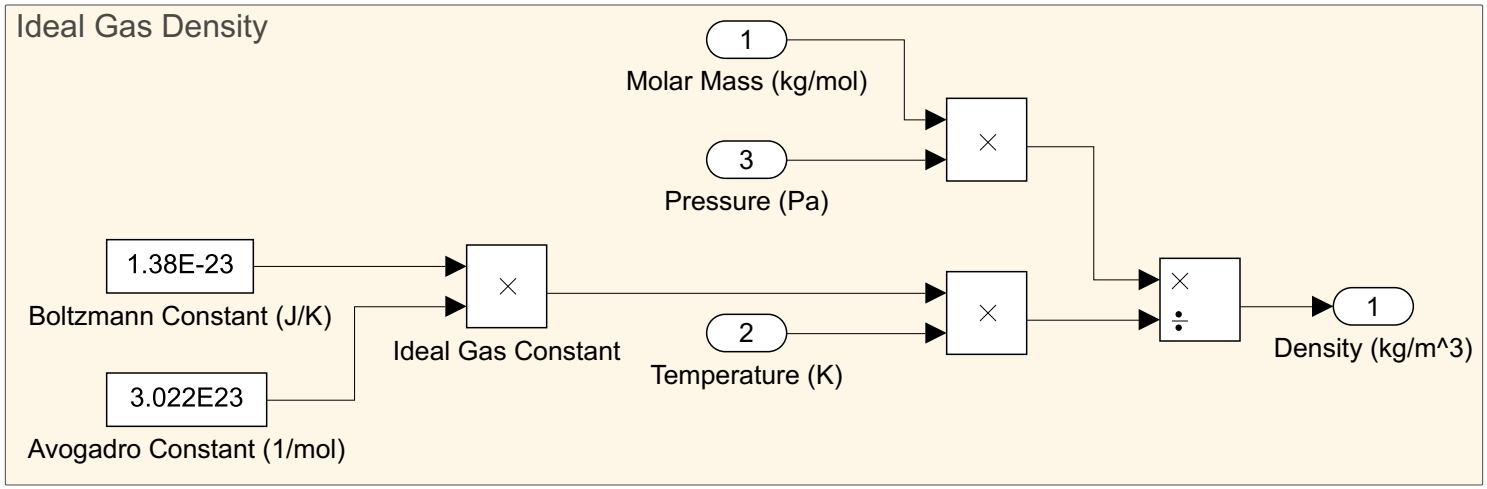

Integrator
[net_force]
[total_mass]
×
Ascent Acceleration (m/s^2)
[ascent_accel]
initial_velocity
Ascent Rate (m/s)
[ascent_rate]
STOP
< 0
Altimeter Noise
initial_altitude
Altitude (m)
[altitude]

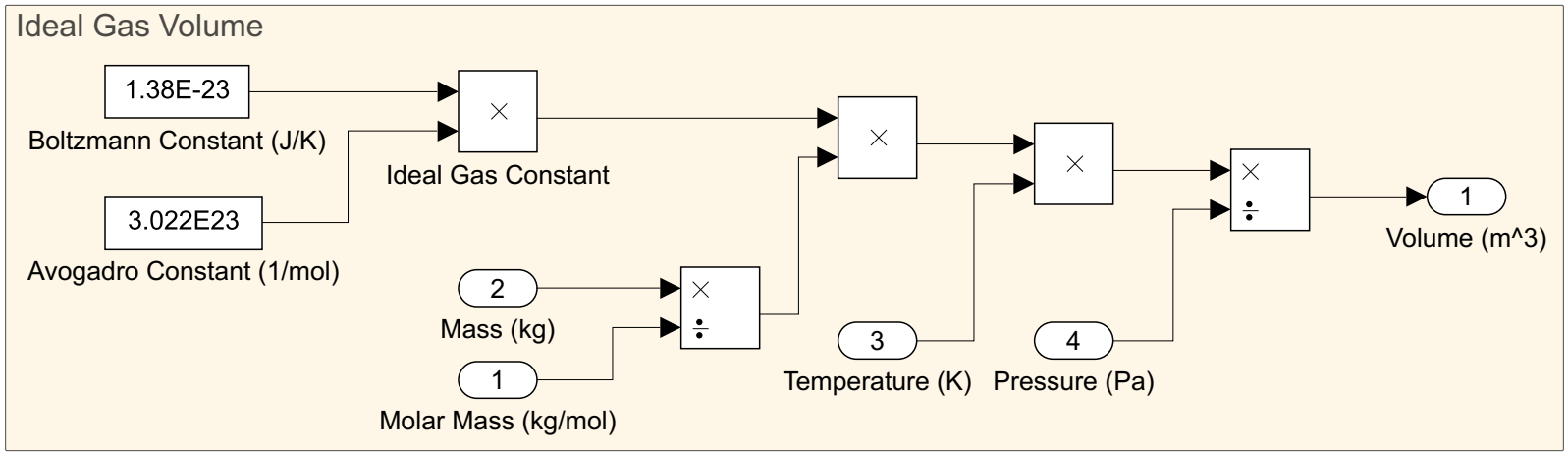

Mass Properties
m_payload
m_balloon
[ballast_remaining]
[total_mass]

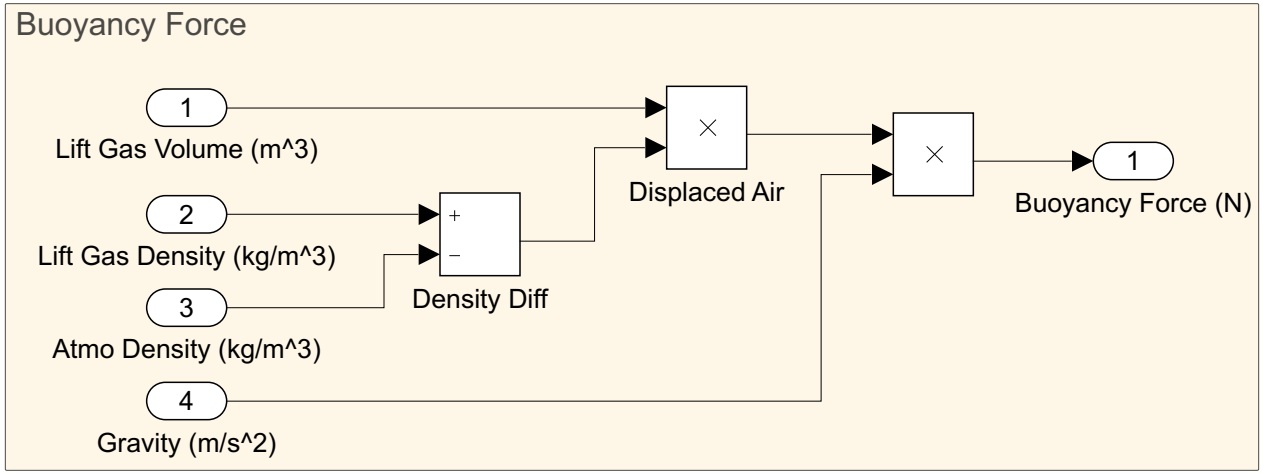

Altitude Controller
[altitude]
target_altitude
continuous_mode
Altitude (m)
altitude_control
Target Altitude (m)
Enable Condition (0 or 1)
Continuous Mode Select
Bleed
Ballast
Control Error
Control Effort
[control_error]
[control_effort]
Altitude Controller
Must wait for time delay and have passed delay altitude
u
0
R
max(u,y) y
Track max altitude
>= delay_altitude
Arm Controller by Altitude
Arm Controller by Time
AND
Disarm if no more ballast
|u|
<= arm_tolerance
Disarm if error diverges
[controller_armed]
Keep running the control loop but shut off ballast/bleed when mass gets too low
m_gas_reserve
m_gas_bleed
[lift_gas_remaining]
≥
Gas Remaining (kg)
m_ballast
Ballast Remaining (kg)
>= 0
[ballast_remaining]

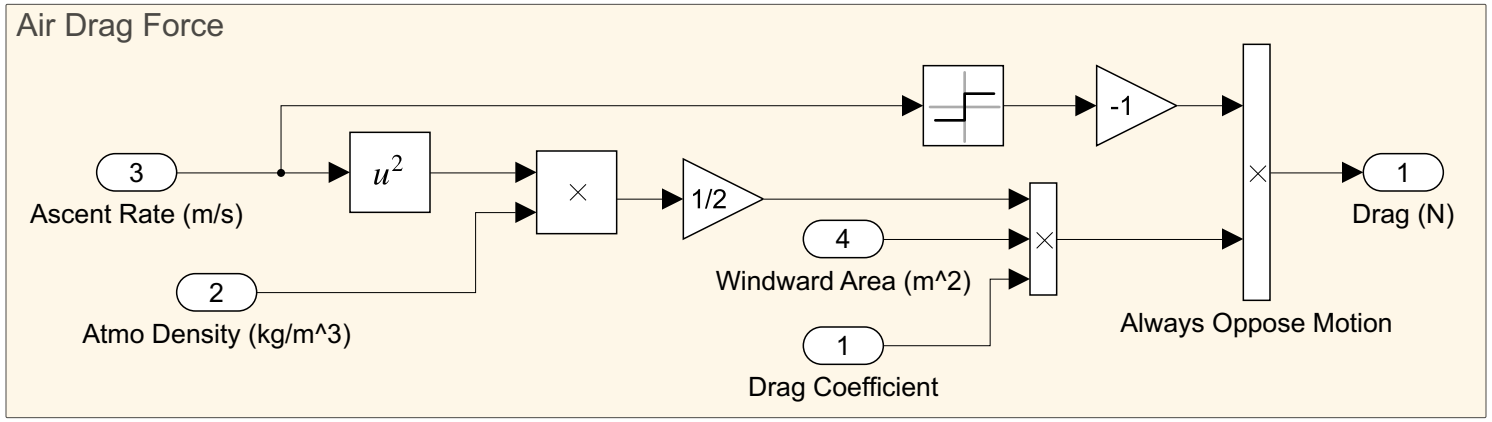

Auxiliary Measurement Parameters
[balloon_volume]
[balloon_density]
[atmo_density]
[total_mass]
Volume (m^3)
free_lift
Lift Gas Density (kg/m^3)
Air Density (kg/m^3)
Total Mass (kg)
Free Lift (kg)
free_lift_kg
Free Lift (kg)

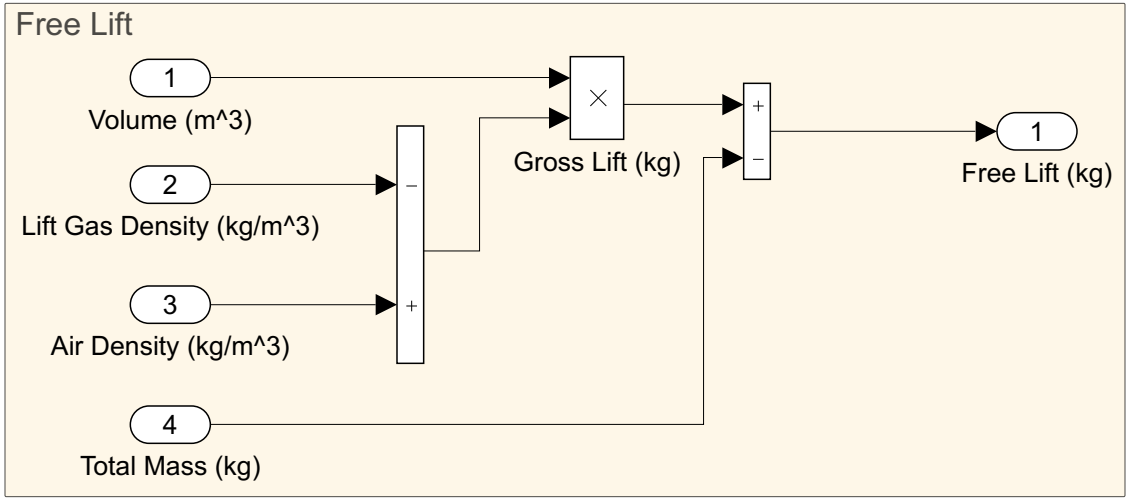

Altitude Control Algorithm
Controller Activation Criteria
2
Target Altitude (m)
3
Control Error
1
Altitude (m)
Error
Switch
3
Enable Condition (0 or 1)
> 0
PID Controller
PID(s)
Continuous Control
Valve Wide Open
Valve Dead Zone
-1
|u|
-1
> 0
Continuous Bleed
< 0
Continuous Ballast
Fixed Mass Flow Control
-mdot_bleed_max
> 0
Fixed Bleed
< 0
-mdot_ballast_max
Fixed Ballast
-1
Continuous Mode vs Fixed Mode Switch
4
Continuous Mode Select
convert
4
Control Effort
2
Ballast
1
Bleed

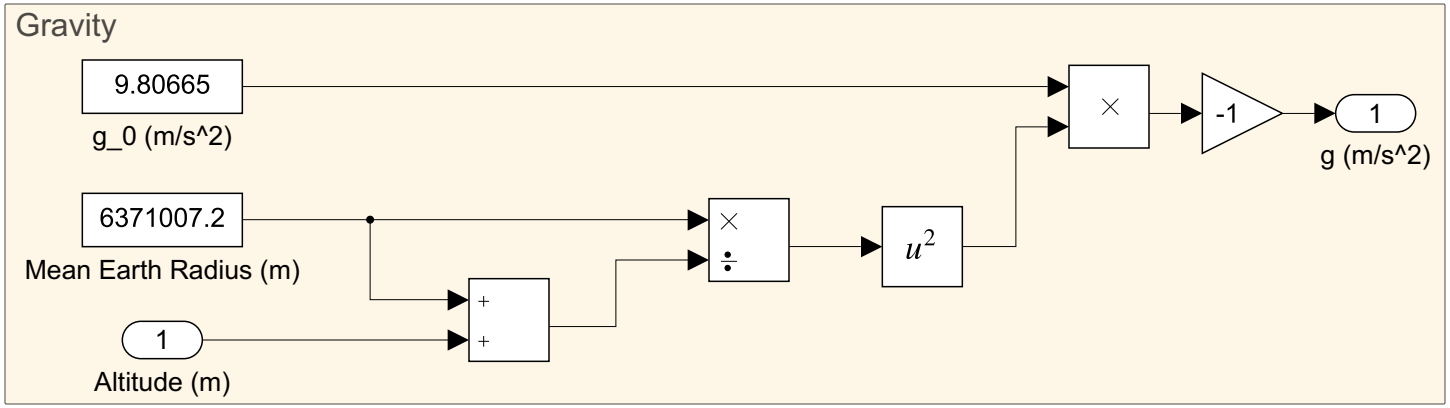

Ideal Gas Density
1
Molar Mass (kg/mol)
3
Pressure (Pa)
1.38E-23
Boltzmann Constant (J/K)
3.022E23
Avogadro Constant (1/mol)
Ideal Gas Constant
2
Temperature (K)
1
Density (kg/m^3)

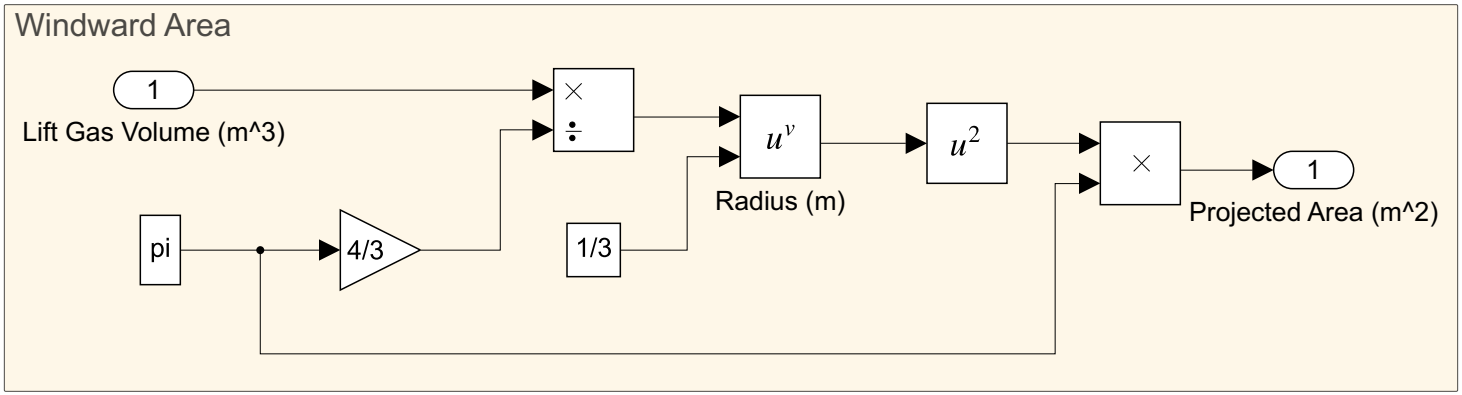

Ideal Gas Volume
1.38E-23
Boltzmann Constant (J/K)
3.022E23
Avogadro Constant (1/mol)
Ideal Gas Constant
2
Mass (kg)
1
Molar Mass (kg/mol)
3
Temperature (K)
4
Pressure (Pa)
1
Volume (m^3)


Buoyancy Force
1
Lift Gas Volume (m^3)
2
Lift Gas Density (kg/m^3)
3
Atmo Density (kg/m^3)
4
Gravity (m/s^2)
+
−
Density Diff
Displaced Air
1
Buoyancy Force (N)


Air Drag Force
3
Ascent Rate (m/s)
u^2
2
Atmo Density (kg/m^3)
1/2
-1
4
Windward Area (m^2)
1
Drag Coefficient
Always Oppose Motion
1
Drag (N)


Free Lift
1
Volume (m^3)
2
Lift Gas Density (kg/m^3)
3
Air Density (kg/m^3)
4
Total Mass (kg)
Gross Lift (kg)
1
Free Lift (kg)


Gravity
9.80665
g_0 (m/s^2)
6371007.2
Mean Earth Radius (m)
1
Altitude (m)
+
+
u^2
-1
1
g (m/s^2)


Windward Area
1
Lift Gas Volume (m^3)
pi
4/3
1/3
Radius (m)
Projected Area (m^2)