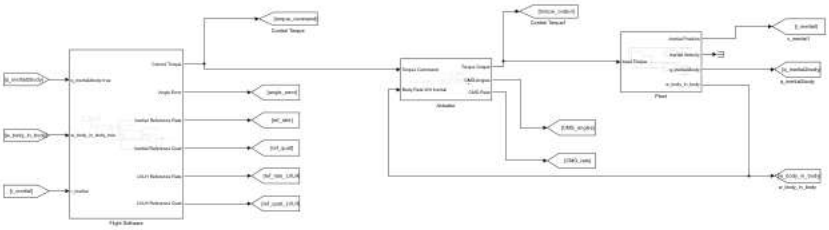
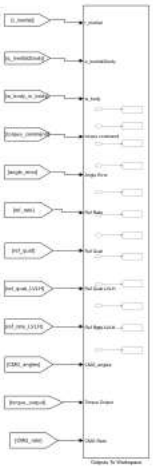
midterm_sim





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Model - midterm_sim

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Full Model Hierarchy

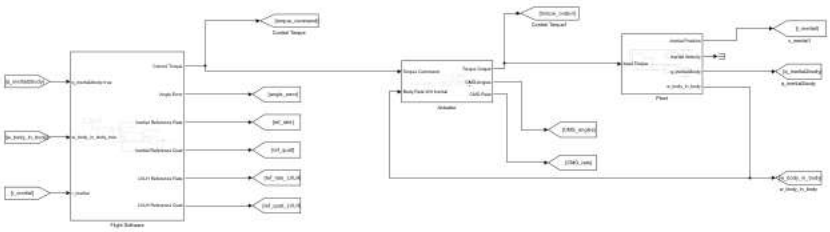
Simulation Parameter	Value
Solver	VariableStepAuto
RelTol	1e-3
Refine	1
MaxOrder	5
ZeroCross	on

[more info]

Machine - midterm_sim

[more info]

System - midterm_sim



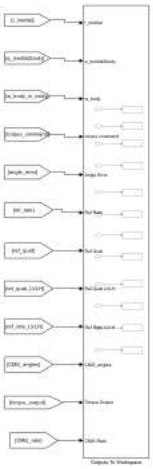


Table 1. From Block Properties

Name	Goto Tag	Icon Display	Goto Blk Name	Goto Blk Location	Defined In Blk
From	q_inerital2body	Tag	q_inertial2body	midterm_sim	SFunction
From1	r_inertial	Tag	v_inertial1	midterm_sim	Integrator
From10	ref_quat_LVLH	Tag	Goto4	midterm_sim	Merge
From11	angle_error	Tag	Goto	midterm_sim	SFunction
From12	CMG_angles	Tag	Goto3	midterm_sim	Integrate Gimbal Angles
From13	torque_output	Tag	Control Torque1	midterm_sim	Add1
From14	CMG_rate	Tag	Goto6	midterm_sim	Saturation
From2	w_body_in_body	Tag	w_body_in_body	midterm_sim	Integrator
From3	q_inerital2body	Tag	q_inertial2body	midterm_sim	SFunction
From4	w_body_in_body	Tag	w_body_in_body	midterm_sim	Integrator
From5	ref_rate	Tag	Goto1	midterm_sim	Add
From6	ref_quat	Tag	Goto2	midterm_sim	SFunction
From7	r_inertial	Tag	v_inertial1	midterm_sim	Integrator
From8	ref_rate_LVLH	Tag	Goto5	midterm_sim	Merge1
From9	torque_command	Tag	Control Torque	midterm_sim	Plus

Table 2. Goto Block Properties

Name	Goto Tag	Icon Display	Tag Visibility	From Blk	From Blk Location	Used By Blk
Control Torque	torque_command	Tag	local	From9	midterm_sim	Add, Control Torque
Control Torque1	torque_output	Tag	local	From13	midterm_sim	Sum, Control Torque7
Goto	angle_error	Tag	local	From11	midterm_sim	Control Torque1
Goto1	ref_rate	Tag	local	From5	midterm_sim	Control Torque2
Goto2	ref_quat	Tag	local	From6	midterm_sim	Control Torque3
Goto3	CMG_angles	Tag	local	From12	midterm_sim	Control Torque4
Goto4	ref_quat_LVLH	Tag	local	From10	midterm_sim	Control Torque5
Goto5	ref_rate_LVLH	Tag	local	From8	midterm_sim	Control Torque6
Goto6	CMG_rate	Tag	local	From14	midterm_sim	Control Torque8

Name	Goto Tag	Icon Display	Tag Visibility	From Blk	From Blk Location	Used By Blk
q_inertial2body	q_inerital2body	Tag	local	From3, From	midterm_sim, midterm_sim	SFunction , SFunction , Quat Output1
v_inertial1	r_inertial	Tag	local	From7, From1	midterm_sim, midterm_sim	SFunction , SFunction , Position Output
w_body_in_body	w_body_in_body	Tag	local	From4, From2	midterm_sim, midterm_sim	SFunction , Quat Body Rate, a elements

Table 3. Terminator Block Properties

Name
Terminator

System - midterm_sim/Actuator

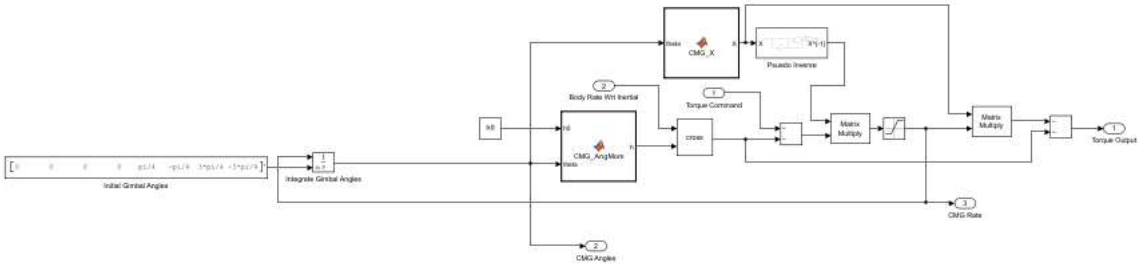


Table 4. Constant Block Properties

Name	Value	Out Data Type Str	Lock Scale	Sample Time	Frame Period
Constant	h0	Inherit: Inherit from 'Constant value'	off	inf	inf
Initial Gimbal Angles	[0 0 0 0 pi/4 -pi/4 3*pi/4 -3*pi/4]'	Inherit: Inherit from 'Constant value'	off	inf	inf

Table 5. CrossProduct Block Properties

Name
Cross Product

Table 6. Inport Block Properties

Name	Port	Defined In Blk
Body Rate Wrt Inertial	2	Integrator
Torque Command	1	Plus

Table 7. Integrator Block Properties

Name	External Reset	Initial Condition Source	Wrap State	Wrapped State Upper Value	Wrapped State Lower Value	Absolute Tolerance	Zero Cross	Continuous State Attributes
Integrate Gimbal Angles	none	external	off	pi	-pi	auto	on	''

Table 8. MATLAB Function Block Properties

Name	Script

MATLAB Function	function h = CMG_AngMom(h0, theta)
	% Produces the angular momentum vector for the CMGs
	
	% Extract alpha and betas
	alphas = theta(1:4);
	betas = theta(5:8);
	
	h = zeros(3,1);
	for ii = 1:4
	    h = h + h0*[sin(alphas(ii)); cos(alphas(ii))*cos(betas(ii)); cos(alphas(ii))*sin(betas(ii))];
	end

Name	Script

MATLAB Function1	`function X = CMG_X(theta)`
	`% Produces the matrix of CMG spin axes`
	
	`% Extract alpha and betas`
	`alphas = theta(1:4);`
	`betas = theta(5:8);`
	
	`X = zeros(3,8);`
	`for ii = 1:4`
	`  X(:,2*ii-1:2*ii) = [cos(alphas(ii)), 0;`
	`  -sin(alphas(ii))*cos(betas(ii)), -cos(alphas(ii))*sin(betas(ii));`
	`  -sin(alphas(ii))*sin(betas(ii)), cos(alphas(ii))*cos(betas(ii))];`
	`end`

Table 9. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnected	Used I Blk
CMG Angles	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	SFunc , Cont Torqu SFunc
CMG Rate	3	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Contr Torqu Integr Gimba Angle Matrix Multip
Torque Output	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Sum, Contr Torqu

Table 10. Product Block Properties

Name	Inputs	Multiplication	Collapse Mode	Collapse Dim	Input Same DT	Out Data Type Str	Lock Scale	Rnd Meth	Saturate On Integer Overflow
Matrix Multiply	2	Matrix(*)	All dimensions	1	off	Inherit: Inherit via internal rule	off	Floor	off
Matrix Multiply1	2	Matrix(*)	All dimensions	1	off	Inherit: Inherit via internal rule	off	Floor	off

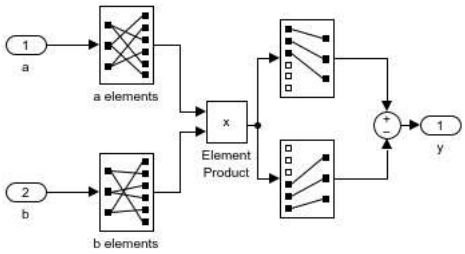
Table 11. Saturate Block Properties

Name	Upper Limit	Lower Limit	Linearize As Gain	Zero Cross	Out Data Type Str	Lock Scale	Rnd Meth
Saturation	rate_max	-1*rate_max	on	on	Inherit: Same as input	off	Floor

Table 12. Sum Block Properties

Name	Icon Shape	Inputs	Collapse Mode	Collapse Dim	Input Same DT	Accum Data Type Str	Out Data Type Str	Lock Scale	Rnd Meth	Saturate On Integer Overflow
Add	rectangular	--	All dimensions	1	off	Inherit: Inherit via internal rule	Inherit: Inherit via internal rule	off	Floor	off
Add1	rectangular	--	All dimensions	1	off	Inherit: Inherit via internal rule	Inherit: Inherit via internal rule	off	Floor	off

System - midterm_sim/Actuator/Cross Product



Cross product of two 3x1 vectors a=[a1 a2 a3], b=[b1 b2 b3]:
y = a x b = (a2b3-a3b2)i + (a3b1-a1b3)j + (a1b2-a2b1)k

Table 13. Inport Block Properties

Name	Port	Defined In Blk
a	1	Integrator
b	2	SFunction

Table 14. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnected	Used By Blk
y	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Add1, Add

Table 15. Product Block Properties

Name	Inputs	Multiplication	Collapse Mode	Collapse Dim	Input Same DT	Out Data Type Str	Lock Scale	Rnd Meth	Saturate On Integer Overflow
Element Product	2	Element-wise(.*)	All dimensions	1	off	Inherit: Inherit via internal rule	off	Simplest	off

Table 16. Selector Block Properties

Name	Number Of Dimensions	Index Mode	Index Option Array	Index Param Array	Output Size Array	Input Port Width	Index Options	Indices	Output Sizes	Runtime Range Checks
a elements	1	One-based	Index vector (dialog)	[2 3 1 3 1 2]	1	3	Index vector (dialog)	[2 3 1 3 1 2]	1	off
b elements	1	One-based	Index vector (dialog)	[3 1 2 2 3 1]	1	3	Index vector (dialog)	[3 1 2 2 3 1]	1	off
Selector2	1	One-based	Index vector (dialog)	[1 2 3]	1	6	Index vector (dialog)	[1 2 3]	1	off
Selector3	1	One-based	Index vector (dialog)	[4 5 6]	1	6	Index vector (dialog)	[4 5 6]	1	off

Table 17. Sum Block Properties

Name	Icon Shape	Inputs	Collapse Mode	Collapse Dim	Input Same DT	Accum Data Type Str	Out Data Type Str	Lock Scale	Rnd Meth	Saturate On Integer Overflow
Sum	round	+|-	All dimensions	1	off	Inherit: Inherit via internal rule	Inherit: Inherit via internal rule	off	Simplest	off

System - midterm_sim/Actuator/Psuedo Inverse

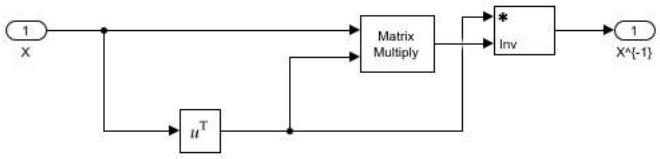


Table 18. Inport Block Properties

Name	Port	Defined In Blk

Name	Port	Defined In Blk
X	1	SFunction

Table 19. Math Block Properties

Name	Operator	Algorithm Method	Signed Power	Output Signal Type	Out Data Type Str	Lock Scale	Rnd Meth	Saturate On Integer Overflow	Intermediate Results Data Type Str	Algorithm Type	Iterations
Transpose	transpose	Exact	off	auto	Inherit: Same as first input	off	Floor	on	Inherit: Inherit via internal rule	Newton-Raphson	3

Table 20. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnected	Used Blk
X^{-1}	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Matrix Multip

Table 21. Product Block Properties

Name	Inputs	Multiplication	Collapse Mode	Collapse Dim	Input Same DT	Out Data Type Str	Lock Scale	Rnd Meth	Saturate On Integer Overflow
Matrix Divide	*/	Matrix(*)	All dimensions	1	off	Inherit: Inherit via internal rule	off	Floor	off
Matrix Multiply	2	Matrix(*)	All dimensions	1	off	Inherit: Inherit via internal rule	off	Floor	off

System - midterm_sim/Flight Software

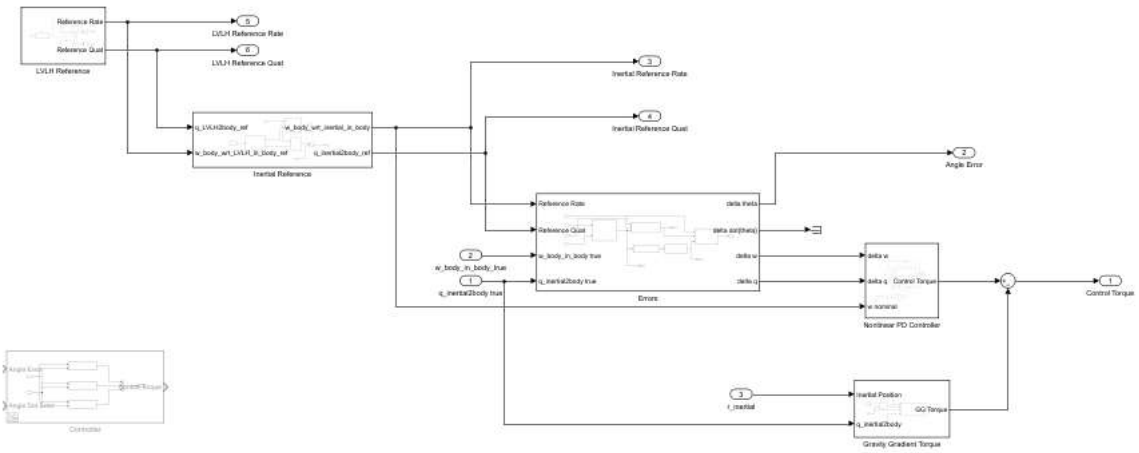


Table 22. Inport Block Properties

Name	Port	Defined In Blk
q_inertial2body true	1	SFunction
r_inertial	3	Integrator
w_body_in_body_true	2	Integrator

Table 23. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnected	Used Blk
Angle Error	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Con Tor
Control Torque	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Add Con Tor
Inertial Reference Quat	4	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	SFu , Co Tor

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnected	Use Blk
Inertial Reference Rate	3	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	SFu , SFu , C Tor SFu , Der
LVLH Reference Quat	6	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Cor Tor SFu , SFu
LVLH Reference Rate	5	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Cor Tor Ad

Table 24. Sum Block Properties

Name	Icon Shape	Inputs	Collapse Mode	Collapse Dim	Input Same DT	Accum Data Type Str	Out Data Type Str	Lock Scale	Rnd Meth	Saturate On Integer Overflow
Plus	round	|+-	All dimensions	1	off	Inherit: Inherit via internal rule	Inherit: Inherit via internal rule	off	Floor	off

Table 25. Terminator Block Properties

Name
Terminator

System - midterm_sim/Flight Software/Errors

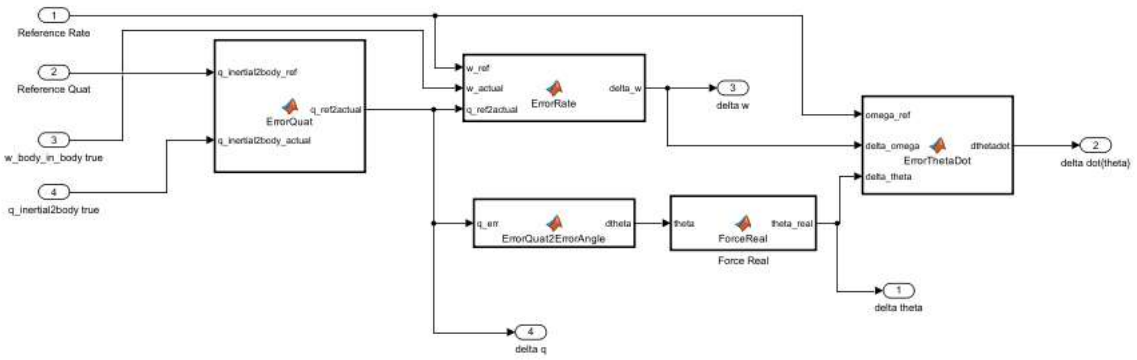


Table 26. Inport Block Properties

Name	Port	Defined In Blk
q_inertial2body true	4	SFunction
Reference Quat	2	SFunction
Reference Rate	1	Add
w_body_in_body true	3	Integrator

Table 27. MATLAB Function Block Properties

Name	Script

Force Real	`function theta_real = ForceReal(theta)`
	
	`theta_real = real(theta);`

MATLAB Function	`function q_ref2actual = ErrorQuat(q_inertial2body_ref, q_inertial2body_actual)`
	
	`q_ref2actual = QuatProduct(q_inertial2body_actual,QuatInv(q_inertial2body_ref));`
	
	`% Force normalization`
	`q_ref2actual = q_ref2actual/norm(q_ref2actual);`

MATLAB Function1	`function delta_w = ErrorRate(w_ref, w_actual, q_ref2actual)`
	
	`delta_w = w_actual - QuatTransform(q_ref2actual,w_ref);`

Name	Script

MATLAB Function2	`function dtheta = ErrorQuat2ErrorAngle(q_err)`
	
	`% Quaternion components`
	`q_v = real(q_err(1:3));`
	`q_s = real(q_err(4));`
	
	`dtheta = [atan2(q_v(1),q_s);`
	`  atan2(q_v(2),q_s);`
	`  atan2(q_v(3),q_s)];`

MATLAB Function3	`function dthetadot = ErrorThetaDot(omega_ref, delta_omega, delta_theta)`
	
	`dthetadot = delta_omega - cross(omega_ref,delta_theta);`

Table 28. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnected	Us Blk
delta dot{theta}	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Ter
delta q	4	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	SFi , SFi , SFi , SFi , Sc
delta theta	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	SFi , C Tor
delta w	3	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	SFi , G

System - midterm_sim/Flight Software/Gravity Gradient Torque

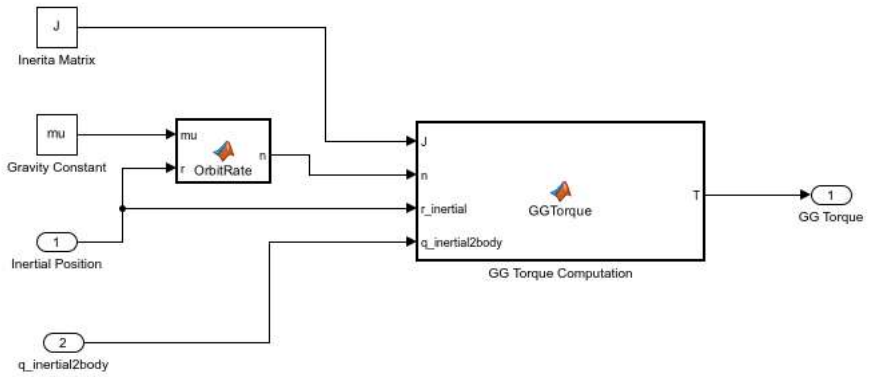


Table 29. Constant Block Properties

Name	Value	Out Data Type Str	Lock Scale	Sample Time	Frame Period
Gravity Constant	mu	Inherit: Inherit from 'Constant value'	off	inf	inf
Inerita Matrix	J	Inherit: Inherit from 'Constant value'	off	inf	inf

Table 30. Inport Block Properties

Name	Port	Defined In Blk
Inertial Position	1	Integrator
q_inertial2body	2	SFunction

Table 31. MATLAB Function Block Properties

Name	Script

Name	Script

GG Torque Computation	`function T = GGTorque(J, n, r_inertial, q_inertial2body)`
	
	`% Down in body frame`
	`down_inertial = -r_inertial/norm(r_inertial);`
	`down_body = QuatTransform(q_inertial2body,down_inertial);`
	
	`% Gravity gradient torque`
	`T = 3*n^2*cross(down_body,J*down_body);`

MATLAB Function	`function n = OrbitRate(mu,r)`
	
	`n = sqrt(mu/norm(r)^3);`

Table 32. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnected	Used By Blk
GG Torque	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Plus

System - midterm_sim/Flight Software/Inertial Reference

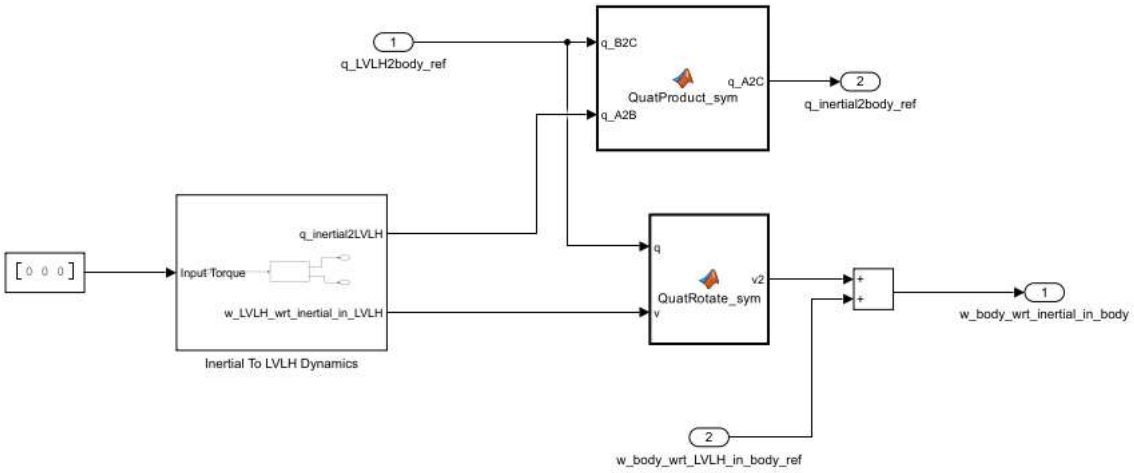


Table 33. Constant Block Properties

Name	Value	Out Data Type Str	Lock Scale	Sample Time	Frame Period
Constant	[0 0 0]'	Inherit: Inherit from 'Constant value'	off	inf	inf

Table 34. Inport Block Properties

Name	Port	Defined In Blk
q_LVLH2body_ref	1	Merge
w_body_wrt_LVLH_in_body_ref	2	Merge1

Table 35. MATLAB Function Block Properties

Name	Script

MATLAB Function	`function q_A2C = QuatProduct_sym(q_B2C,q_A2B)`
	
	`q_A2C = QuatProduct(q_B2C,q_A2B);`

MATLAB Function1	`function v2 = QuatRotate_sym(q,v)`
	
	`v2 = QuatTransform(q,v);`

Table 36. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnecte Value
q_inertial2body_ref	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnecte Value
w_body_wrt_inertial_in_body	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0

Table 37. Sum Block Properties

Name	Icon Shape	Inputs	Collapse Mode	Collapse Dim	Input Same DT	Accum Data Type Str	Out Data Type Str	Lock Scale	Rnd Meth	Saturate On Integer Overflow
Add	rectangular	++	All dimensions	1	off	Inherit: Inherit via internal rule	Inherit: Inherit via internal rule	off	Floor	off

System - midterm_sim/Flight Software/Inertial Reference/Inertial To LVLH Dynamics

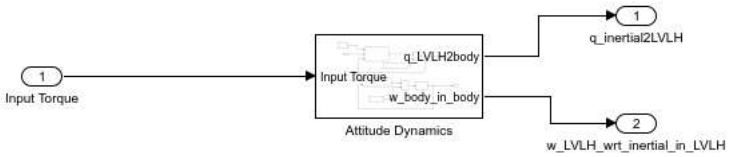


Table 38. Inport Block Properties

Name	Port	Defined In Blk
Input Torque	1	Constant

Table 39. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconne Value
q_inertial2LVLH	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0
w_LVLH_wrt_inertial_in_LVLH	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0

System - midterm_sim/Flight Software/Inertial Reference/Inertial To LVLH Dynamics/Attitude Dynamics

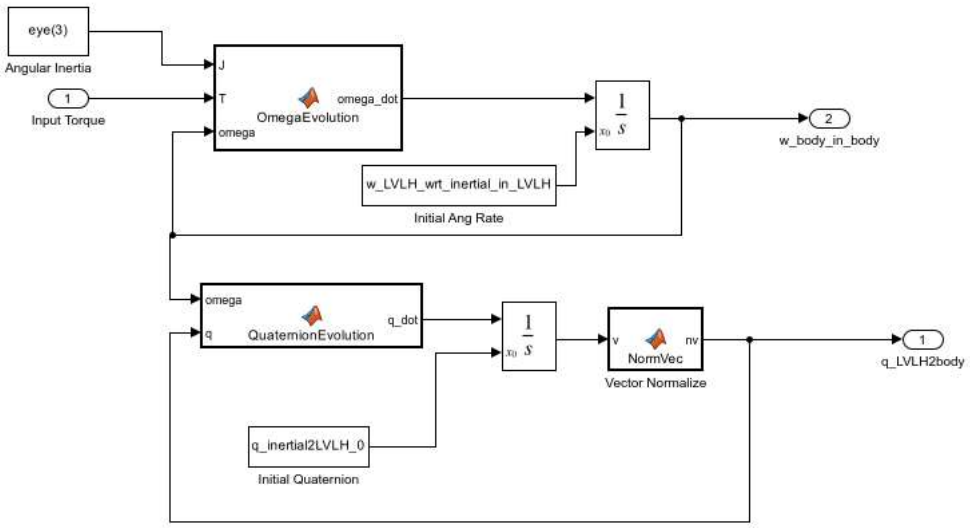


Table 40. Constant Block Properties

Name	Value	Out Data Type Str	Lock Scale	Sample Time	Frame Period
Angular Inertia	eye(3)	Inherit: Inherit from 'Constant value'	off	inf	inf
Initial Ang Rate	w_LVLH_wrt_inertial_in_LVLH	Inherit: Inherit from 'Constant value'	off	inf	inf
Initial Quaternion	q_inertial2LVLH_0	Inherit: Inherit from 'Constant value'	off	inf	inf

Table 41. Inport Block Properties

Name	Port	Defined In Blk
Input Torque	1	Constant

Table 42. Integrator Block Properties

Name	External Reset	Initial Condition Source	Wrap State	Wrapped State Upper Value	Wrapped State Lower Value	Absolute Tolerance	Zero Cross	Continuous State Attributes
Integrator	none	external	off	pi	-pi	auto	on	''
Integrator1	none	external	off	pi	-pi	auto	on	''

Table 43. MATLAB Function Block Properties

Name	Script

MATLAB Function	`function q_dot = QuaternionEvolution(omega, q)`
	`intermed = [omega; 0];`
	`q_dot = 0.5*QuatProduct(intermed,q);`

MATLAB Function1	`function omega_dot = OmegaEvolution(J, T, omega)` `omega_dot = J\(T - cross(omega, J*omega));`

Vector Normalize	`function nv = NormVec(v)`
	
	`nv = v/norm(v);`

Table 44. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params A 1DFor Ou When Unconnec
q_LVLH2body	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on
w_body_in_body	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on

System - midterm_sim/Flight Software/LVLH Reference

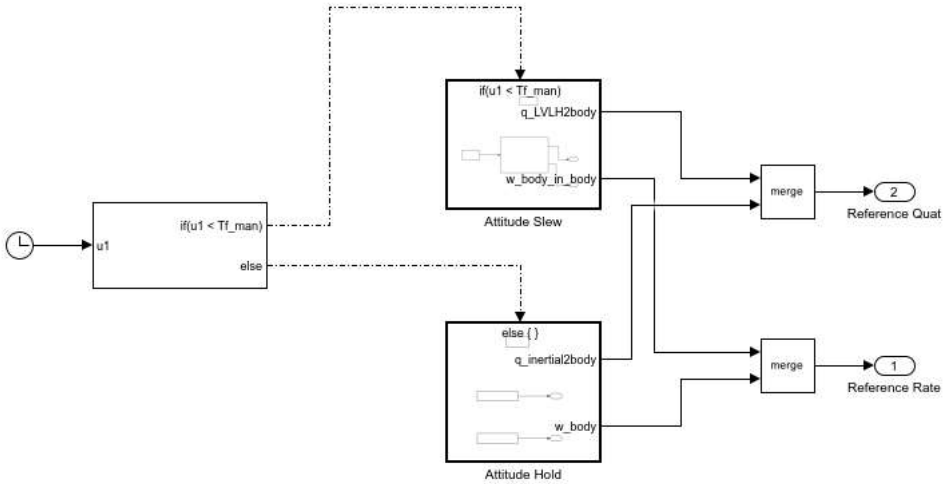


Table 45. Clock Block Properties

Name	Display Time	Decimation
Clock	off	10

Table 46. If Block Properties

Name	Num Inputs	If Expression	Show Else	Zero Cross
If	1	u1 < Tf_man	on	on

Table 47. Merge Block Properties

Name	Inputs	Allow Unequal Input Port Widths
Merge	2	off
Merge1	2	off

Table 48. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnected	Use Blk
Reference Quat	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Con Tor SFu , SFu
Reference Rate	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Con Tor Ad

System - midterm_sim/Flight Software/LVLH Reference/Attitude Hold

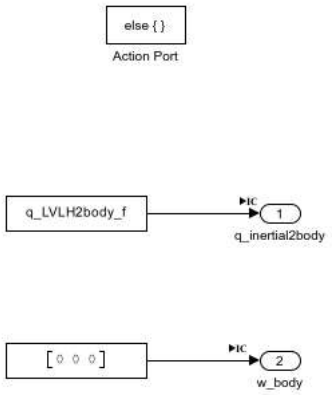


Table 49. ActionPort Block Properties

Name	Initialize States	Propagate Var Size
Action Port	held	Only when execution is resumed

Table 50. Constant Block Properties

Name	Value	Out Data Type Str	Lock Scale	Sample Time	Frame Period
Constant	q_LVLH2body_f	Inherit: Inherit from 'Constant value'	off	inf	inf
Constant1	[0 0 0]'	Inherit: Inherit from 'Constant value'	off	inf	inf

Table 51. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnecte
q_inertial2body	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on
w_body	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on

System - midterm_sim/Flight Software/LVLH Reference/Attitude Slew

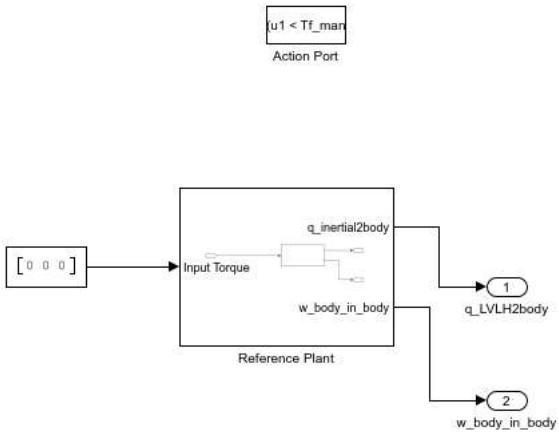


Table 52. ActionPort Block Properties

Name	Initialize States	Propagate Var Size
Action Port	held	Only when execution is resumed

Table 53. Constant Block Properties

Name	Value	Out Data Type Str	Lock Scale	Sample Time	Frame Period
Constant	[0 0 0]'	Inherit: Inherit from 'Constant value'	off	inf	inf

Table 54. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params A 1DFor Ou When Unconnec
q_LVLH2body	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on
w_body_in_body	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on

System - midterm_sim/Flight Software/LVLH Reference/Attitude Slew/Reference Plant

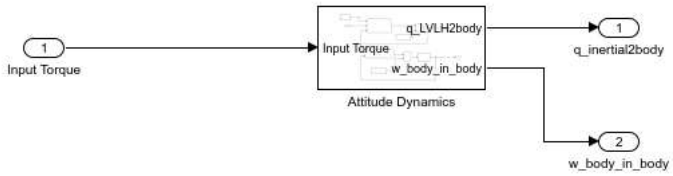


Table 55. Inport Block Properties

Name	Port	Defined In Blk
Input Torque	1	Constant

Table 56. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params A 1DFor Ou When Unconnec
q_inertial2body	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on
w_body_in_body	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on

System - midterm_sim/Flight Software/LVLH Reference/Attitude Slew/Reference Plant/Attitude Dynamics

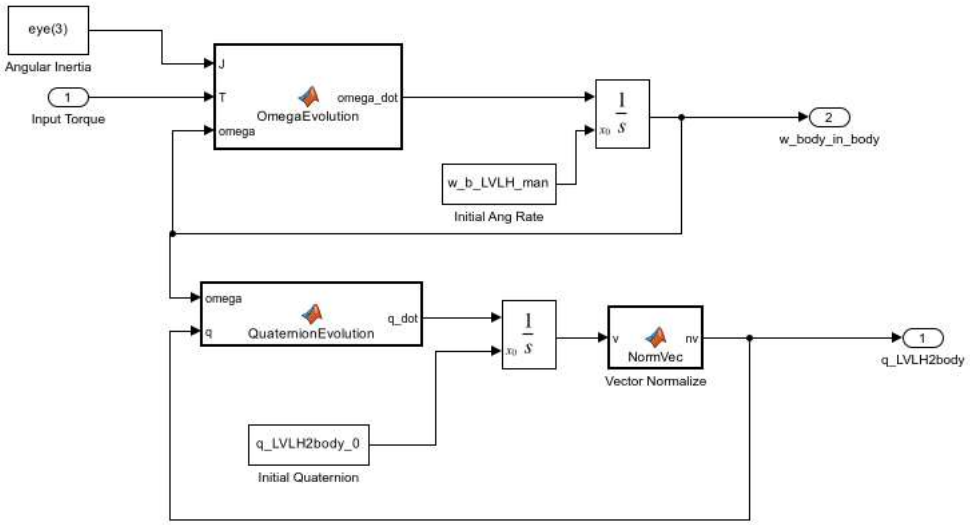


Table 57. Constant Block Properties

Name	Value	Out Data Type Str	Lock Scale	Sample Time	Frame Period
Angular Inertia	eye(3)	Inherit: Inherit from 'Constant value'	off	inf	inf
Initial Ang Rate	w_b_LVLH_man	Inherit: Inherit from 'Constant value'	off	inf	inf
Initial Quaternion	q_LVLH2body_0	Inherit: Inherit from 'Constant value'	off	inf	inf

Table 58. Inport Block Properties

Name	Port	Defined In Blk
Input Torque	1	Constant

Table 59. Integrator Block Properties

Name	External Reset	Initial Condition Source	Wrap State	Wrapped State Upper Value	Wrapped State Lower Value	Absolute Tolerance	Zero Cross	Continuous State Attributes
Integrator	none	external	off	pi	-pi	auto	on	''
Integrator1	none	external	off	pi	-pi	auto	on	''

Table 60. MATLAB Function Block Properties

Name	Script

MATLAB Function	`function q_dot = QuaternionEvolution(omega, q)`
	`intermed = [omega; 0];`
	`q_dot = 0.5*QuatProduct(intermed,q);`

MATLAB Function1	`function omega_dot = OmegaEvolution(J, T, omega)` `omega_dot = J\(T - cross(omega, J*omega));`

Vector Normalize	`function nv = NormVec(v)`
	
	`nv = v/norm(v);`

Table 61. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params A 1DFor Ou When Unconnec
q_LVLH2body	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on
w_body_in_body	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on

System - midterm_sim/Flight Software/Nonlinear PD Controller

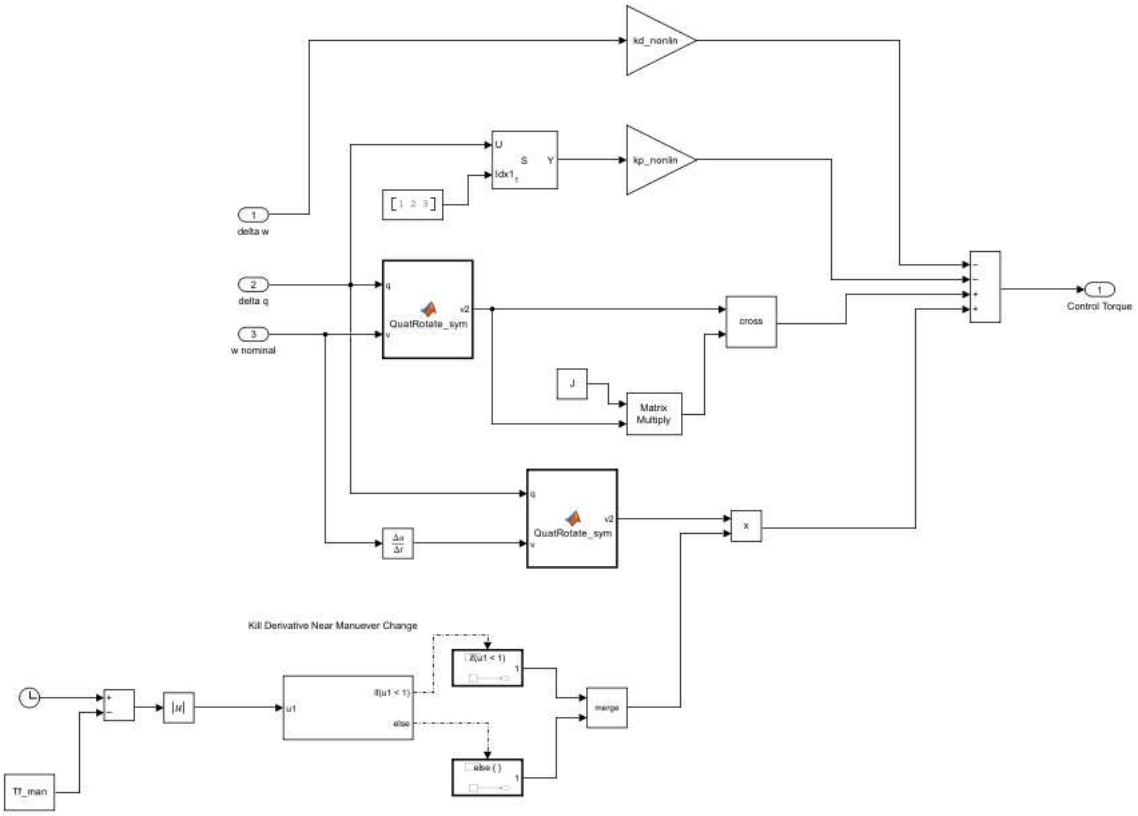


Table 62. Abs Block Properties

Name	Zero Cross	Out Data Type Str	Lock Scale	Rnd Meth	Saturate On Integer Overflow
Abs	on	Inherit: Same as input	off	Floor	off

Table 63. Clock Block Properties

Name	Display Time	Decimation
Clock	off	10

Table 64. Constant Block Properties

Name	Value	Out Data Type Str	Lock Scale	Sample Time	Frame Period
Constant	J	Inherit: Inherit from 'Constant value'	off	inf	inf
Constant1	[1 2 3]'	Inherit: Inherit from 'Constant value'	off	inf	inf
Constant2	Tf_man	Inherit: Inherit from 'Constant value'	off	inf	inf

Table 65. CrossProduct Block Properties

Name
Cross Product

Table 66. Derivative Block Properties

Name	Coefficient In TFapproximation
Derivative	Inf

Table 67. Gain Block Properties

Name	Gain	Multiplication	Param Data Type Str	Out Data Type Str	Lock Scale	Rnd Meth	Saturate On Integer Overflow
Gain	kp_nonlin	Element-wise(K.*u)	Inherit: Inherit via internal rule	Inherit: Inherit via internal rule	off	Floor	off
Gain1	kd_nonlin	Element-wise(K.*u)	Inherit: Inherit via internal rule	Inherit: Inherit via internal rule	off	Floor	off

Table 68. If Block Properties

Name	Num Inputs	If Expression	Show Else	Zero Cross

Name	Num Inputs	If Expression	Show Else	Zero Cross
If	1	u1 < 1	on	on

Table 69. Inport Block Properties

Name	Port	Defined In Blk
delta q	2	SFunction
delta w	1	SFunction
w nominal	3	Add

Table 70. MATLAB Function Block Properties

Name	Script
MATLAB Function1	`function v2 = QuatRotate_sym(q,v)` `v2 = QuatTransform(q,v);`
MATLAB Function2	`function v2 = QuatRotate_sym(q,v)` `v2 = QuatTransform(q,v);`

Table 71. Merge Block Properties

Name	Inputs	Allow Unequal Input Port Widths
Merge	2	off

Table 72. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnected	Used By Blk
Control Torque	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Plus

Table 73. Product Block Properties

Name	Inputs	Multiplication	Collapse Mode	Collapse Dim	Input Same DT	Out Data Type Str	Lock Scale	Rnd Meth	Saturate On Integer Overflow
Matrix Multiply	2	Matrix(*)	All dimensions	1	off	Inherit: Inherit via internal rule	off	Floor	off
Product	2	Element-wise(.*)	All dimensions	1	off	Inherit: Inherit via internal rule	off	Floor	off

Table 74. Selector Block Properties

Name	Number Of Dimensions	Index Mode	Index Option Array	Index Param Array	Output Size Array	Input Port Width	Index Options	Indices	Output Sizes	Runtime Range Checks
Selector	1	One-based	Index vector (port)	[1 3]	1	4	Index vector (port)	[1 3]	1	off

Table 75. Sum Block Properties

Name	Icon Shape	Inputs	Collapse Mode	Collapse Dim	Input Same DT	Accum Data Type Str	Out Data Type Str	Lock Scale	Rnd Meth	Saturate On Integer Overflow
Add	rectangular	--++	All dimensions	1	off	Inherit: Inherit via internal rule	Inherit: Inherit via internal rule	off	Floor	off
Subtract	rectangular	+-	All dimensions	1	off	Inherit: Inherit via internal rule	Inherit: Inherit via internal rule	off	Floor	off

System - midterm_sim/Flight Software/Nonlinear PD Controller/If Action Subsystem

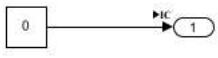


Table 76. ActionPort Block Properties

Name	Initialize States	Propagate Var Size
Action Port	held	Only when execution is resumed

Table 77. Constant Block Properties

Name	Value	Out Data Type Str	Lock Scale	Sample Time	Frame Period
Constant	0	Inherit: Inherit from 'Constant value'	off	inf	inf

Table 78. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnected	Used By Blk
Out1	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Merge

System - midterm_sim/Flight Software/Nonlinear PD Controller/If Action Subsystem1

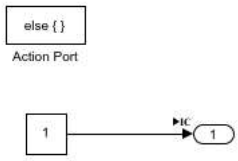


Table 79. ActionPort Block Properties

Name	Initialize States	Propagate Var Size
Action Port	held	Only when execution is resumed

Table 80. Constant Block Properties

Name	Value	Out Data Type Str	Lock Scale	Sample Time	Frame Period
Constant	1	Inherit: Inherit from 'Constant value'	off	inf	inf

Table 81. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnected	Used By Blk
Out1	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Merge

System - midterm_sim/Outputs To Workspace

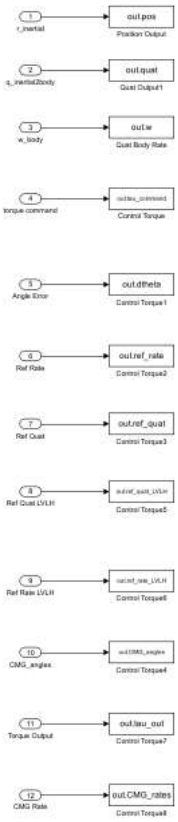


Table 82. Inport Block Properties

Name	Port	Defined In Blk
Angle Error	5	SFunction
CMG Rate	12	Saturation
CMG_angles	10	Integrate Gimbal Angles
q_inertial2body	2	SFunction
r_inertial	1	Integrator
Ref Quat	7	SFunction
Ref Quat LVLH	8	Merge
Ref Rate	6	Add
Ref Rate LVLH	9	Merge1
torque command	4	Plus
Torque Output	11	Add1
w_body	3	Integrator

Table 83. ToWorkspace Block Properties

Name	Variable Name	Max Data Points	Decimation	Save Format	Save 2DSignal	Fixpt As Fi
Control Torque	tau_command	inf	1	Array	3-D array (concatenate along third dimension)	on
Control Torque1	dtheta	inf	1	Array	3-D array (concatenate along third dimension)	on
Control Torque2	ref_rate	inf	1	Array	3-D array (concatenate along third dimension)	on
Control Torque3	ref_quat	inf	1	Array	3-D array (concatenate along third dimension)	on
Control Torque4	CMG_angles	inf	1	Array	3-D array (concatenate along third dimension)	on
Control Torque5	ref_quat_LVLH	inf	1	Array	3-D array (concatenate along third dimension)	on
Control Torque6	ref_rate_LVLH	inf	1	Array	3-D array (concatenate along third dimension)	on
Control Torque7	tau_out	inf	1	Array	3-D array (concatenate along third dimension)	on
Control Torque8	CMG_rates	inf	1	Array	3-D array (concatenate along third dimension)	on
Position Output	pos	inf	1	Array	3-D array (concatenate along third dimension)	on

Name	Variable Name	Max Data Points	Decimation	Save Format	Save 2DSignal	Fixpt As Fi
Quat Body Rate	w	inf	1	Array	3-D array (concatenate along third dimension)	on
Quat Output1	quat	inf	1	Array	3-D array (concatenate along third dimension)	on

System - midterm_sim/Plant

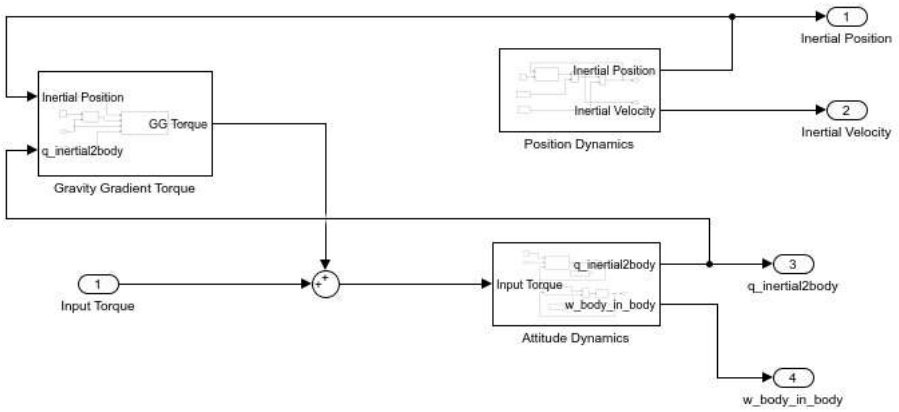


Table 84. Inport Block Properties

Name	Port	Defined In Blk
Input Torque	1	Add1

Table 85. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params A 1DFor Ou When Unconnec
Inertial Position	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on
Inertial Velocity	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on
q_inertial2body	3	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on
w_body_in_body	4	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on

Table 86. Sum Block Properties

Name	Icon Shape	Inputs	Collapse Mode	Collapse Dim	Input Same DT	Accum Data Type Str	Out Data Type Str	Lock Scale	Rnd Meth	Saturate On Integer Overflow
Sum	round	++|	All dimensions	1	off	Inherit: Inherit via internal rule	Inherit: Inherit via internal rule	off	Floor	off

System - midterm_sim/Plant/Attitude Dynamics

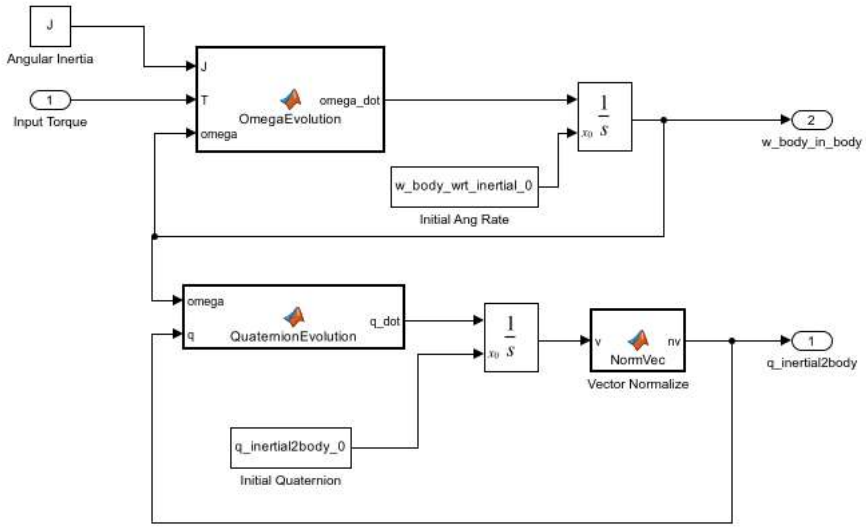


Table 87. Constant Block Properties

Name	Value	Out Data Type Str	Lock Scale	Sample Time	Frame Period
Angular Inertia	J	Inherit: Inherit from 'Constant value'	off	inf	inf
Initial Ang Rate	w_body_wrt_inertial_0	Inherit: Inherit from 'Constant value'	off	inf	inf
Initial Quaternion	q_inertial2body_0	Inherit: Inherit from 'Constant value'	off	inf	inf

Table 88. Inport Block Properties

Name	Port	Defined In Blk
Input Torque	1	Sum

Table 89. Integrator Block Properties

Name	External Reset	Initial Condition Source	Wrap State	Wrapped State Upper Value	Wrapped State Lower Value	Absolute Tolerance	Zero Cross	Continuous State Attributes
Integrator	none	external	off	pi	-pi	auto	on	''
Integrator1	none	external	off	pi	-pi	auto	on	''

Table 90. MATLAB Function Block Properties

Name	Script

MATLAB Function	`function q_dot = QuaternionEvolution(omega, q)`
	`intermed = [omega; 0];`
	`q_dot = 0.5*QuatProduct(intermed,q);`

MATLAB Function1	`function omega_dot = OmegaEvolution(J, T, omega)` `omega_dot = J\(T - cross(omega, J*omega));`

Vector Normalize	`function nv = NormVec(v)`
	
	`nv = v/norm(v);`

Table 91. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params A 1DFor Ou When Unconnec
q_inertial2body	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params A 1DFor Ou When Unconnec
w_body_in_body	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on

System - midterm_sim/Plant/Gravity Gradient Torque

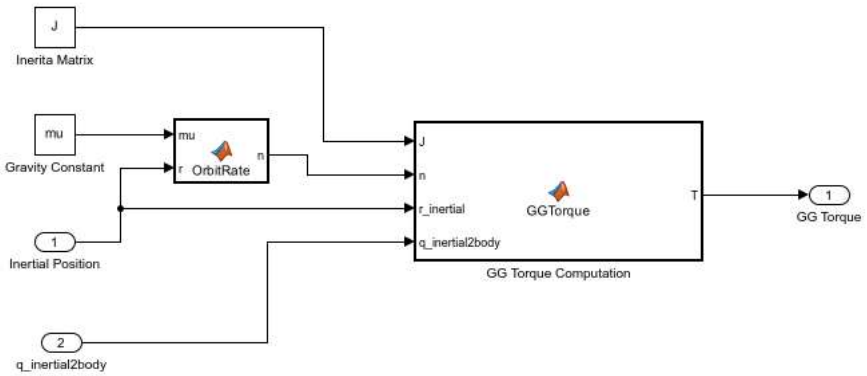


Table 92. Constant Block Properties

Name	Value	Out Data Type Str	Lock Scale	Sample Time	Frame Period
Gravity Constant	mu	Inherit: Inherit from 'Constant value'	off	inf	inf
Inerita Matrix	J	Inherit: Inherit from 'Constant value'	off	inf	inf

Table 93. Inport Block Properties

Name	Port	Defined In Blk
Inertial Position	1	Integrator
q_inertial2body	2	SFunction

Table 94. MATLAB Function Block Properties

Name	Script

GG Torque Computation	`function T = GGTorque(J, n, r_inertial, q_inertial2body)`
	
	`% Down in body frame`
	`down_inertial = -r_inertial/norm(r_inertial);`
	`down_body = QuatTransform(q_inertial2body,down_inertial);`
	
	`% Gravity gradient torque`
	`T = 3*n^2*cross(down_body,J*down_body);`

MATLAB Function	`function n = OrbitRate(mu,r)`
	
	`n = sqrt(mu/norm(r)^3);`

Table 95. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnected	Used By Blk
GG Torque	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Sum

System - midterm_sim/Plant/Position Dynamics

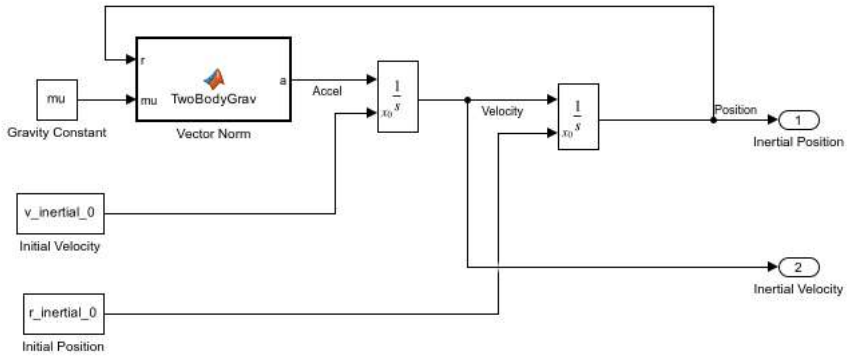


Table 96. Constant Block Properties

Name	Value	Out Data Type Str	Lock Scale	Sample Time	Frame Period
Gravity Constant	mu	Inherit: Inherit from 'Constant value'	off	inf	inf
Initial Position	r_inertial_0	Inherit: Inherit from 'Constant value'	off	inf	inf
Initial Velocity	v_inertial_0	Inherit: Inherit from 'Constant value'	off	inf	inf

Table 97. Integrator Block Properties

Name	External Reset	Initial Condition Source	Initial Condition	Wrap State	Wrapped State Upper Value	Wrapped State Lower Value	Absolute Tolerance	Zero Cross	Continuous State Attributes
Integrator	none	external	[6871, 0, 0]'	off	pi	-pi	auto	on	''
Integrator1	none	external	[0, 7.6166, 0]'	off	pi	-pi	auto	on	''

Table 98. MATLAB Function Block Properties

Name	Script

Vector Norm	`function a = TwoBodyGrav(r,mu)`
	
	`nr = norm(r);`
	`a = -mu*r/(nr^3);`

Table 99. Outport Block Properties

Name	Port	Storage Class	Icon Display	Output Function Call	Lock Scale	Bus Virtuality	Data Mode	Unit	Var Size Sig	Signal Type	Ensure Outport Is Virtual	Source Of Initial Output Value	Output When Disabled	Must Resolve To Signal Object	Output When Un Connected	Output When Unconnected Value	Vector Params As 1DFor Out When Unconnected	Used Blk
Inertial Position	1	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	SFun SFun Posit Outp SFun SFun SFun
Inertial Velocity	2	Auto	Port number	off	off	inherit	inherit	inherit	Inherit	auto	off	Dialog	held	off	off	0	on	Term Integ

Appendix

Table 100. Block Type Count

BlockType	Count	Block Names
Outport	44	CMG Angles, CMG Rate, y, X^{-1}, Torque Output, Angle Error, Control Torque, delta dot{theta}, delta q, delta theta, delta w, GG Torque, Inertial Reference Quat, Inertial Reference Rate, q_LVLH2body, w_body_in_body, q_inertial2LVLH, w_LVLH_wrt_inertial_in_LVLH, q_inertial2body_ref, w_body_wrt_inertial_in_body, LVLH Reference Quat, LVLH Reference Rate, q_inertial2body, w_body, q_LVLH2body, w_body_in_body, q_inertial2body, w_body_in_body, q_LVLH2body, w_body_in_body, Reference Quat, Reference Rate, Control Torque, Out1, Out1, q_inertial2body, w_body_in_body, GG Torque, Inertial Position, Inertial Velocity, Inertial Position, Inertial Velocity, q_inertial2body, w_body_in_body

BlockType	Count	Block Names
Inport	39	Body Rate Wrt Inertial, a, b, X, Torque Command, Reference Quat, Reference Rate, q_inertial2body true, w_body_in_body true, Inertial Position, q_inertial2body, Input Torque, Input Torque, q_LVLH2body_ref, w_body_wrt_LVLH_in_body_ref, Input Torque, Input Torque, delta q, delta w, w nominal, q_inertial2body true, r_inertial, w_body_in_body_true, Angle Error, CMG Rate, CMG_angles, Ref Quat, Ref Quat LVLH, Ref Rate, Ref Rate LVLH, Torque Output, q_inertial2body, r_inertial, torque command, w_body, Input Torque, Inertial Position, q_inertial2body, Input Torque
Constant	27	Constant, Initial Gimbal Angles, Gravity Constant, Inerita Matrix, Constant, Angular Inertia, Initial Ang Rate, Initial Quaternion, Constant, Constant1, Constant, Angular Inertia, Initial Ang Rate, Initial Quaternion, Constant, Constant1, Constant2, Constant, Constant, Angular Inertia, Initial Ang Rate, Initial Quaternion, Gravity Constant, Inerita Matrix, Gravity Constant, Initial Position, Initial Velocity
MATLAB Function	25	MATLAB Function, MATLAB Function1, Force Real, MATLAB Function, MATLAB Function1, MATLAB Function2, MATLAB Function3, GG Torque Computation, MATLAB Function, MATLAB Function, MATLAB Function1, Vector Normalize, MATLAB Function, MATLAB Function1, MATLAB Function, MATLAB Function1, Vector Normalize, MATLAB Function1, MATLAB Function2, MATLAB Function, MATLAB Function1, Vector Normalize, GG Torque Computation, MATLAB Function, Vector Norm
SubSystem	21	Actuator, Psuedo Inverse, Flight Software, Errors, Gravity Gradient Torque, Inertial Reference, Inertial To LVLH Dynamics, Attitude Dynamics, LVLH Reference, Attitude Hold, Attitude Slew, Reference Plant, Attitude Dynamics, Nonlinear PD Controller, If Action Subsystem, If Action Subsystem1, Outputs To Workspace, Plant, Attitude Dynamics, Gravity Gradient Torque, Position Dynamics
From	15	From, From1, From10, From11, From12, From13, From14, From2, From3, From4, From5, From6, From7, From8, From9
ToWorkspace	12	Control Torque, Control Torque1, Control Torque2, Control Torque3, Control Torque4, Control Torque5, Control Torque6, Control Torque7, Control Torque8, Position Output, Quat Body Rate, Quat Output1
Goto	12	Control Torque, Control Torque1, Goto, Goto1, Goto2, Goto3, Goto4, Goto5, Goto6, q_inertial2body, v_inertial1, w_body_in_body
Integrator	9	Integrate Gimbal Angles, Integrator, Integrator1, Integrator, Integrator1, Integrator, Integrator1, Integrator, Integrator1
Sum	8	Add, Add1, Sum, Add, Add, Subtract, Plus, Sum
Product	7	Element Product, Matrix Multiply, Matrix Multiply1, Matrix Divide, Matrix Multiply, Matrix Multiply, Product
Selector	5	Selector2, Selector3, a elements, b elements, Selector
ActionPort	4	Action Port, Action Port, Action Port, Action Port
Merge	3	Merge, Merge1, Merge
Terminator	2	Terminator, Terminator
If	2	If, If
Gain	2	Gain, Gain1
CrossProduct (m)	2	Cross Product, Cross Product
Clock	2	Clock, Clock
Saturate	1	Saturation
Math	1	Transpose
Derivative	1	Derivative
Abs	1	Abs

Table 101. Model Variables

Variable Name	Parent Blocks	Calling character vector	Value
J	Inerita Matrix Constant Angular Inertia Inerita Matrix	J J J J	[24181836 3783405 3898808 ; 3783405 37621803 -1171849 ; 3898808 -1171849 51576634]
Tf_man	If Constant2	Tf_man Tf_man	7110
h0	Constant	h0	4881
kd_nonlin	Gain1	kd_nonlin	500000
kp_nonlin	Gain	kp_nonlin	500
mu	Gravity Constant Gravity Constant Gravity Constant	mu mu mu	398600
q_LVLH2body_0	Initial Quaternion	q_LVLH2body_0	[0.028 ; -0.0788 ; 0.1141 ; 0.9899]

Variable Name	Parent Blocks	Calling character vector	Value
q_LVLH2body_f	Constant	`q_LVLH2body_f`	[-0.0607 ; -0.0343 ; -0.7045 ; 0.7062]
q_inertial2LVLH_0	Initial Quaternion	`q_inertial2LVLH_0`	[0 ; 0 ; 0 ; 1]
q_inertial2body_0	Initial Quaternion	`q_inertial2body_0`	[0.028 ; -0.0788 ; 0.1141 ; 0.9899]
r_inertial_0	Initial Position	`r_inertial_0`	[6771 ; 0 ; 0]
rate_max	Saturation Saturation	`-1*rate_max` `rate_max`	Inf
v_inertial_0	Initial Velocity	`v_inertial_0`	[0 ; 7.6726 ; 0]
w_LVLH_wrt_inertial_in_LVLH	Initial Ang Rate	`w_LVLH_wrt_inertial_in_LVLH`	[0 ; -0.0011332 ; 0]
w_b_LVLH_man	Initial Ang Rate	`w_b_LVLH_man`	[-4.5052e-05 ; 2.877e-06 ; -0.00024977]
w_body_wrt_inertial_0	Initial Ang Rate	`w_body_wrt_inertial_0`	[-0.00025097 ; -0.0011019 ; 8.3192e-05]

Table 102. Model Functions

Function Name	Parent Blocks	Calling character vector
Inf	Derivative	`Inf`
eye	Angular Inertia Angular Inertia	`eye(3)` `eye(3)`

pi	Integrate Gimbal Angles
	Integrator
	Integrator1
	Integrator
	Integrator1
	Integrator
	Integrator1
	Integrator
	Integrator1
	Initial Gimbal Angles
	Integrate Gimbal Angles
	Integrator
	Integrator1
	Integrator
	Integrator1
	Integrator
	Integrator1
	Integrator
	Integrator1
		
		`-pi`
		`-pi`
		`-pi`
		`-pi`
		`-pi`
		`-pi`
		`-pi`
		`-pi`
		`-pi`
		`[0 0 0 0 pi/4 -pi/4 3*pi/4 -3*pi/4]'`
		`pi`
		`pi`
		`pi`
		`pi`
		`pi`
		`pi`
		`pi`
		`pi`
		`pi`