

Take Off And Landing Stage Of Aircraft with Matlab Simulation

Er. Naser.F.AB.Elmaidub¹, Dr.A.K. Bharadwaj²
^{1, 2}(Department, of Electrical Engineering, SHIATS Allahabad, India)

Abstract: The simulation contains a comprehensive view about the stage of takeoff and landing with auto control. This model display the simulation of takeoff and landing of aircraft with the help of simulink matlab. Some useful graph explain about positions angles and altitude of aircraft. In this model auto controller are used. Starting and journey of the model by the different Engineers . Mr Naser Give GUI based simulation work in his sereach study in Phd.This model run on matlab software. In matlab many block for design the aircraft take off and landing stages.

I. Introduction

This model is a variant of the vrtkoff example that shows how to trace trajectory of a moving object (the plane) in the scene.VR Tracer block adds the following behavior to the scene visualization:A marker is placed at the current position of the traced object in regular time intervals specified by the block sample time. Markers form a visible trace of the object's trajectory.

The distance between markers indicates the speed of the object at given position.In addition, marker color can be dynamically set using the second block input to represent another model property or status.

VR Tracer block allows you to specify the following parameters:

- Associated VRML File
- Parent node of markers to create (useful when the traced object is inside other object in the scene hierarchy)
- General marker shape to be selected from the listbox (select None for displaying line / triads below only)
- Checkboxes to select whether you want to display trajectory as a line and/or axis-aligned triads
- Marker scale
- Marker color, to be defined in block input or in the block mask.
- Sample time
- Checkbox to ensure that a viewer window is open during simulation

In this example, a tetrahedron shape is used as a general shape marker, together with both trajectory line and triads.

II. Review And Letretural

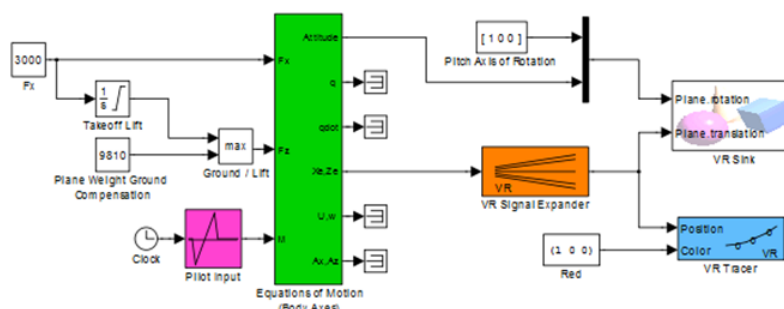
Aircraft take off and landing stages were designed in 2007. Mr Naser was reseach more in takeoff and landing and give some improved design using matlab simulation. In 2009 Mr. Grijesh Singh worked for landing of aircraft and give great job in simulation but some problem in autocrollers. Same time Mr Jaccob Itlacy give take off and landing program with using C Language and apreceated by all, great job.

Mr. Naser continuously reseach for takeoff and landing using matlab simulation. In 2012 Mr naser again made some simulation of landing in his M Tech Program.Finally in 2014 Mr Naser give both take off and landing stage using GUI program in matlab. In matlab he give the great achievement and thanks to matlab software group.

III. Methodology

Design Control Take Off Stage A/C

Plane Take-Off with Trajectory Tracing



Full Model Hierarchy

1. take off

Simulation Parameter	Value
Solver	ode45
RelTol	1e-3
Refine	1
MaxOrder	5
ZeroCross	on

Table 1.3 DOF equations of motion Block Properties

Name	V ini	Theta ini	Alpha ini	Q ini	Pos ini	Mass	Iyy	G
Equations of Motion (Body Axes)	0	0	0	0	[0 0]	1000	1000	-9.81

Table 2. Clock Block Properties

Name	Display Time	Decimation
Clock	off	10

Table 3. Constant Block Properties

Name	Value	Sampling Mode	Out Min	Out Max	Out Data Type Str	Sample Time	Frame Period
Fx	3000	Sample based	[]	[]	Inherit: Inherit from 'Constant value'	inf	inf
Pitch Axis of Rotation	[1 0 0]	Sample based	[]	[]	Inherit: Inherit from 'Constant value'	inf	inf
Plane Weight Ground Compensation	9810	Sample based	[]	[]	Inherit: Inherit from 'Constant value'	inf	inf
Red	[1 0 0]	Sample based	[]	[]	Inherit: Inherit from 'Constant value'	inf	inf

Table 4. Integrator Block Properties

Name	External Reset	Initial Source	Condition	Limit Output	Upper Limit	Saturation	Lower Limit	Saturation	Zero Cross	Continuous State Attributes
Takeoff Lift	none	internal		on	11000		-Inf		off	"

Table 5. Lookup Block Properties

Name	Input Values	Table	Look Up Meth	Out Min	Out Max	Out Data Type Str
Pilot Input	[0 1 2 8 9 15]	[0 0 -20 20 0 0]	Interpolation-Extrapolation	[]	[]	Inherit: Same as input

Table 6. MinMax Block Properties

Name	Function	Inputs	Input Same DT	Out Min	Out Max	Out Data Type Str	Zero Cross
Ground / Lift	max	2	on	[]	[]	Inherit: Inherit via internal rule	off

Table 7. Mux Block Properties

Name	Inputs	Display Option
Mux3	2	bar

Table 8. Terminator Block Properties

Name
Terminator1
Terminator2
Terminator3
Terminator6

Table 9. VR Signal Expander Block Properties

Name	Outwidth	Outidx
VR Signal Expander	3	[3 2]

Table 10. VR Tracer Block Properties

Name	Vrml File	Marker Name	Use Lines	Use Triads	Marker Scale	Marker Color Selection	Ts	Force Open	Viewer
VR Tracer	vrtkoff.wrl	Tetrahedron	on	on	[1 1 1]	Block input	0.5	off	

Table 11. Virtual Reality Sink Block Properties

Name	Sample Time	View Enable	Remote View	Fields Written	World File Name	World Description	Auto View	Video Dimensions
VR Sink	0.05	on	off	Plane.rotation.4.1.double#Plane.translation.3.1.double	vrtkoff.wrl	VR Plane Take-Off	on	[]

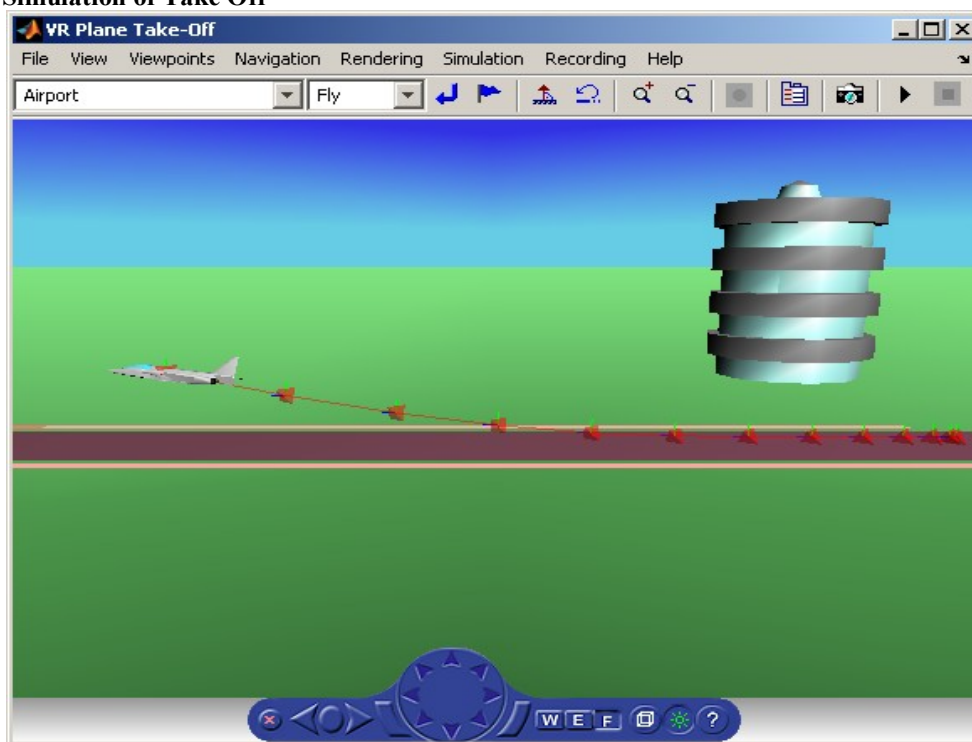
Table 12. Block Type Count

BlockType	Count	Block Names
Terminator	4	<u>Terminator1</u> , <u>Terminator2</u> , <u>Terminator3</u> , <u>Terminator6</u>
Constant	4	<u>Fx</u> , <u>Pitch Axis of Rotation</u> , <u>Plane Weight Ground Compensation</u> , <u>Red</u>
Virtual Reality Sink (m)	1	<u>VR Sink</u>
VR Tracer (m)	1	<u>VR Tracer</u>
VR Signal Expander (m)	1	<u>VR Signal Expander</u>
Mux	1	<u>Mux3</u>
MinMax	1	<u>Ground / Lift</u>
Lookup	1	<u>Pilot Input</u>
Integrator	1	<u>Takeoff Lift</u>
Clock	1	<u>Clock</u>
3 DOF equations of motion (m)	1	<u>Equations of Motion (Body Axes)</u>

Table 13. Model Functions

Function Name	Parent Blocks	Calling string
Inf	<u>Takeoff Lift</u>	-Inf

Result of Simulation of Take Off



Landing Stage Of Aircraft

Landing of Aircraft with Controllers

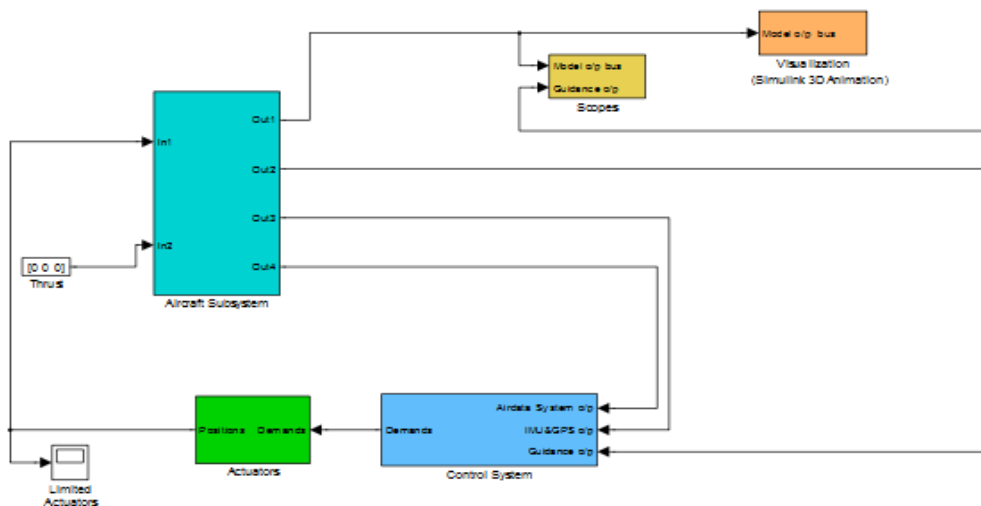


Table 1. Constant Block Properties

Name	Value	Sampling Mode	Out Min	Out Max	Out Data Type Str	Sample Time	Frame Period
Thrust	[0 0 0]	Sample based	[]	[]	Inherit: Inherit from 'Constant value'	inf	inf

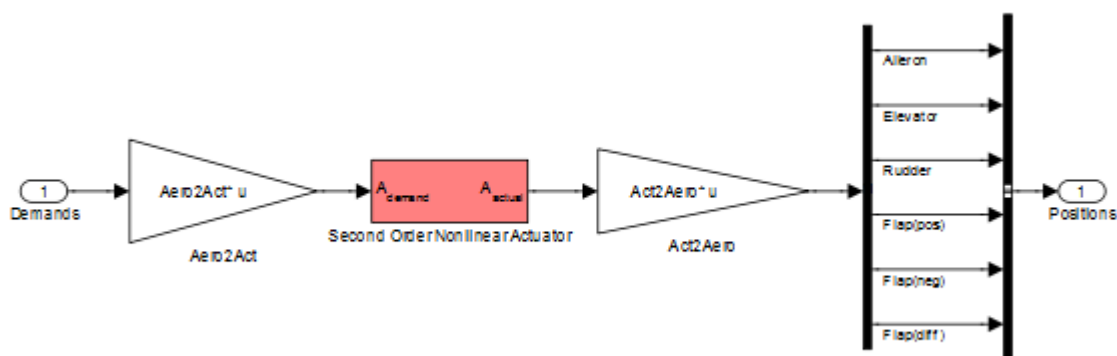


Table 2. BusCreator Block Properties

Name	Inputs	Display Option	Bus Object	Non Virtual Bus
Bus Creator1	6	bar	BusObject	off

Table 3. Demux Block Properties

Name	Outputs	Display Option	Bus Selection Mode
Demux	6	none	off

Table 4. Gain Block Properties

Name	Gain	Multiplication	Param Min	Param Max	Param Data Type Str	Out Min	Out Max	Out Data Type Str
Demands	Act2Aero	Matrix(K*u)	[]	[]	Inherit: Same as input	[]	[]	Inherit: Same as input
Act2Aero	Aero2Act	Matrix(K*u)	[]	[]	Inherit: Same as input	[]	[]	Inherit: Same as input

Table 5. Import Block Properties

Simulation Parameter	Value
Solver	ode45
RelTol	1e-3
Refine	1
MaxOrder	5
ZeroCross	on

Table 6. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Size Sig	Out Min	Out Max	Out Data Type Str	Source Of Initial Output Value	Output When Disabled	Initial Output	Used By Blk
Potions	1	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Abs2, Product2, Abs, Product4, Abs1, Product6, Product, Product6, Abs1, Product4, Abs, Product2, Abs2, Product, Product, Abs2, Product1, Product2, Product3, Limited Actuators

Table 7. Second Order Nonlinear Actuator Block Properties

Name	Wn fin	Z fin	Fin max	Fin min	Fin maxrate	Fin act 0
Second Order Nonlinear Actuator	wn_act	z_act	max_lim	min_lim	inf	0

Table 8. BusCreator Block Properties

Name	Inputs	Display Option	Bus Object	Non Virtual Bus
Model o/p bus	11	bar	BusObject	off

Table 9. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
In1	1	<u>Demux</u> , <u>Demux</u> , <u>Demux</u> , <u>Demux</u> , <u>Demux</u> , <u>Demux</u>	[]	[]
In2	2	<u>Thrust</u>	[]	[]

Name	Port	Icon Display	Bus Object	Var Size Sig	Out Min	Out Max	Out Data Type Str	Source Of Initial Output Value	Output When Disabled	Initial Output	Used By Blk
Out1	1	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Unit Conversion, <u>Product1</u> , <u>Demux</u> , Unit Conversion, Attitudes Accelerations

											Mach, Attitudes Accelerations Mach, Unit Conversion, Inertial Position, <u>Bus</u> <u>Selector</u> , Sum2, <u>Bus Selector</u> , <u>Select</u> <u>Phi</u> , <u>Bus Selector</u> , <u>Bus Selector</u> , <u>Bus</u> <u>Selector</u> , <u>u.v. w.</u> , <u>Dot Product</u> , <u>Dot</u> <u>Product</u> , <u>Selector</u> , <u>Demux</u>
Out2	2	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Demux2, <u>Demux</u> , [1.4], [2.5], [3.6]
Out3	3	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Sum2, Sum1
Out4	4	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Unit Conversion, <u>Product1</u>

Table 10. Outport Block Properties

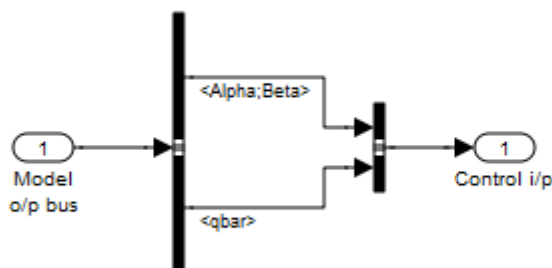


Table 11. BusCreator Block Properties

Name	Inputs	Display Option	Bus Object	Non Virtual Bus
Bus Creator1	2	bar	BusObject	off

Table 12. BusSelector Block Properties

Name	Output Signals	Output As Bus	Input Signals
Bus Selector	Alpha;Beta,qbar	off	pdot;qdot;rdot pqr phi;theta;psi DCM Accels Vb Ve Xe { Alpha;Beta , Alpha Beta } Mach qbar

Table 13. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
Model bus	o/p 1	Reshape, p,q,r , phi theta psi, Reshape (9) to [3x3] column-major, Force ---> Acc, Unit Conversion, Unit Conversion, xe,ye,ze, Incidence, Sideslip, Product1, 1/2rhoV^2	[]	[]

Table 14. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Sig	Size	Out Min	Out Max	Out Data Type Str	Source Initial Output Value	Of Output When Disabled	Initial Output	Used By Blk
Control i/p	1	Port number	BusObject	Inherit	[]	[]	[]	Inherit: auto	Dialog	held	[]	Unit Conversion, Product1

System - landing/Aircraft Subsystem/Guidance System

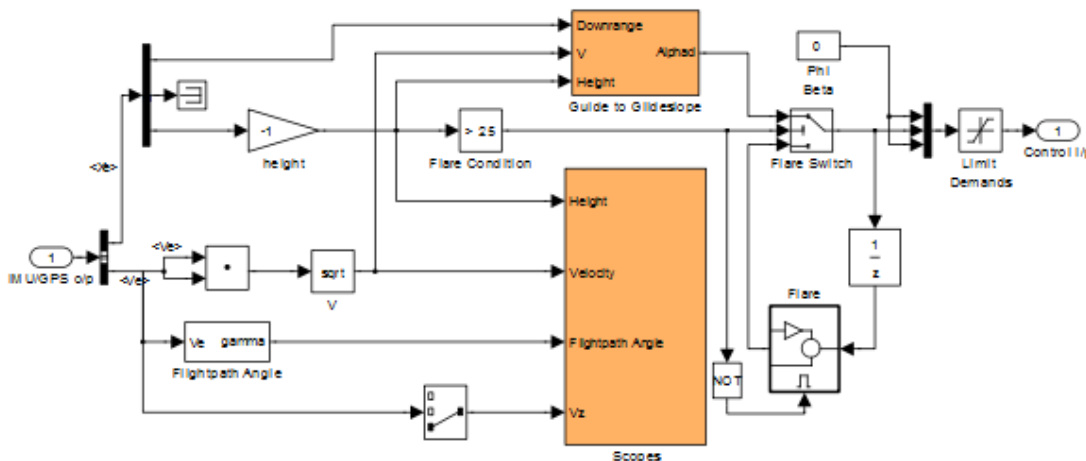


Table 15. BusSelector Block Properties

Name	Output Signals	Output As Bus	Input Signals
Bus Selector	Xe, Ve	off	pqr phi;theta;psi DCM Accels Vb Ve Xe

Table 16. Compare To Constant Block Properties

Name	Relop	Const	Logic Out Data Type Mode	Zero Cross
Flare Condition	>	25.0	boolean	off

Table 17. Constant Block Properties

Name	Value	Sampling Mode	Out Min	Out Max	Out Data Type Str	Sample Time	Frame Period
Phi Beta	0	Sample based	[]	[]	Inherit: Inherit from 'Constant value'	inf	inf

Table 18. Demux Block Properties

Name	Outputs	Display Option	Bus Selection Mode
Demux	3	none	off

Table 19. DotProduct Block Properties

Name	Input Same DT	Out Min	Out Max	Out Data Type Str
Dot Product	off	[]	[]	Inherit: Inherit via internal rule

Table 20. Gain Block Properties

Name	Gain	Multiplication	Param Min	Param Max	Param Data Type Str	Out Min	Out Max	Out Data Type Str
height	-1	Element-wise(K.*u)	[]	[]	Inherit: Same as input	[]	[]	Inherit: Same as input

Table 21. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
IMU/GPS o/p	1	p,q,r , phi theta psi, Reshape (9) to [3x3] column-major, Force ---> Acc, Unit Conversion, Unit Conversion, xe,ye,ze	[]	[]

Table 22. Logic Block Properties

Name	Operator	Inputs	Icon Shape	All Ports Same	Out Data Type Str
Logical Operator	NOT	2	rectangular	on	Inherit: Logical (see Configuration Parameters: Optimization)

Table 23. Math Block Properties

Name	Operator	Output Signal Type	Out Min	Out Max	Out Data Type Str	Intermediate Results Data Type Str	Algorithm Type	Iterations
V	sqrt	auto	[]	[]	Inherit: Same as first input	Inherit: Inherit via internal rule	Newton-Raphson	3

Table 24. Mux Block Properties

Name	Inputs	Display Option
Mux	3	bar

Table 25. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Size	Out Min	Out Max	Out Data Type Str	Source Of Initial Output Value	Output When Disabled	Initial Output	Used By Blk
Control i/p	1	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Demux2, Demux, [1.4], [2.5], [3.6]

Table 26. Saturate Block Properties

Name	Upper Limit	Lower Limit	Linearize As Gain	Zero Cross	Out Min	Out Max	Out Data Type Str
Limit Demands	[20 25 5]	[-20 -10 -5]	on	on	[]	[]	Inherit: Same as input

Table 27. 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
Selector	1	One-based	Index vector (dialog)	[3]	1	3	Index vector (dialog)	[3]	1

Table 28. Switch Block Properties

Name	Criteria	Threshold	Input Same DT	Out Min	Out Max	Out Data Type Str	Zero Cross	Allow Diff Input Sizes
Flare Switch	u2 >= Threshold	0.5	on	[]	[]	Inherit: Inherit via internal rule	on	off

Table 29. Terminator Block Properties

Name
Terminator

Table 30. UnitDelay Block Properties

Name	X0	Sample Time
Unit Delay	0	0.1

System - landing/Aircraft Subsystem/Guidance System/Flare

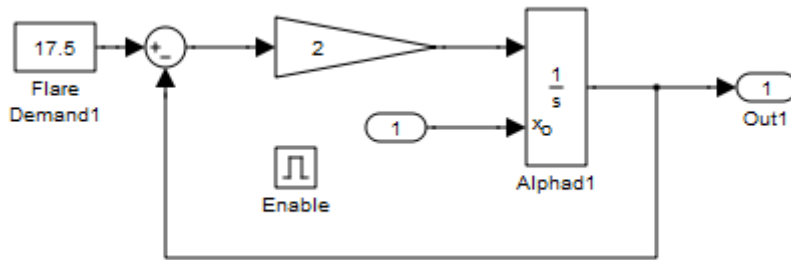


Table 31. Constant Block Properties

Name	Value	Sampling Mode	Out Min	Out Max	Out Data Type Str	Sample Time	Frame Period
Flare Demand1	17.5	Sample based	[]	[]	Inherit: Inherit from 'Constant value'	inf	inf

Table 32. EnablePort Block Properties

Name	States When Enabling	Propagate Var Size	Show Output Port	Zero Cross
Enable	reset	Only when enabling	off	on

Table 33. Gain Block Properties

Name	Gain	Multiplication	Param Min	Param Max	Param Data Type Str	Out Min	Out Max	Out Data Type Str
Gain1	2	Element-wise(K.*u)	[]	[]	Inherit: Same as input	[]	[]	Inherit: Same as input

Table 34. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
In1	1	Unit Delay	[]	[]

Table 35. Integrator Block Properties

Name	External Reset	Initial Condition Source	Zero Cross	Continuous State Attributes
Alphad1	none	external	on	"

Table 36. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Sig	Size	Out Min	Out Max	Out Data Type Str	Source Initial Output Value	Of Output When Disabled	Initial Output	Used By Blk
Out1	1	Port number	BusObject	Inherit	[]	[]	[]	Inherit: auto	Dialog	held	[0]	Flare Switch, Sum2

Table 37. Sum Block Properties

Name	Icon Shape	Inputs	Collapse Mode	Collapse Dim	Input Same DT	Accum Data Type Str	Out Min	Out Max	Out Data Type Str
Sum2	round	+-	All dimensions	1	on	Inherit: Inherit via internal rule	[]	[]	Inherit: Same as first input

System - landing/Aircraft Subsystem/Guidance System/Flightpath Angle

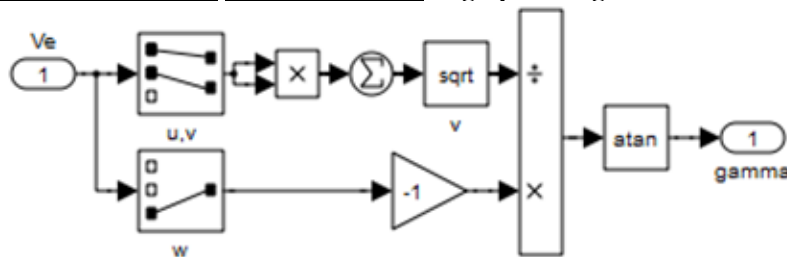


Table 38. Gain Block Properties

Name	Gain	Multiplication	Param Min	Param Max	Param Data Type Str	Out Min	Out Max	Out Data Type Str
rad-->deg4	-1	Element-wise(K.*u)	[]	[]	Inherit: Same as input	[]	[]	Inherit: Same as input

Table 39. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
Ve	1	Unit Conversion	[]	[]

Table 40. Math Block Properties

Name	Operator	Output Signal Type	Out Min	Out Max	Out Data Type Str	Intermediate Results Data Type Str	Algorithm Type	Iterations
v	sqrt	auto	[]	[]	Inherit: Same as first input	Inherit: Inherit via internal rule	Newton-Raphson	3

Table 41. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Size	Out Min	Out Max	Out Data Type Str	Source Of Initial Output Value	Output When Disabled	Initial Output	Used By Blk
gamma	1	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Unit Conversion

Table 42. Product Block Properties

Name	Inputs	Multiplication	Collapse Mode	Collapse Dim	Input Same DT	Out Min	Out Max	Out Data Type Str
product	2	Element-wise(*)	All dimensions	1	on	[]	[]	Inherit: Same as first input
product1	/*	Element-wise(*)	All dimensions	1	on	[]	[]	Inherit: Same as first input

Table 43. Selector Block Properties

Name	Number Of Dimensions	Index Mode	Index Array	Option	Index Param Array	Output Size Array	Input Port Width	Index Options	Indices	Output Sizes
u,v	1	One-based	Index (dialog)	vector	[1 2]	1	3	Index (dialog)	[1 2]	1
w	1	One-based	Index (dialog)	vector	3	1	3	Index (dialog)	3	1

Table 44. Sum Block Properties

Name	Icon Shape	Inputs	Collapse Mode	Collapse Dim	Input Same DT	Accum Data Type Str	Out Min	Out Max	Out Data Type Str
Sum2	round	+	All dimensions	1	on	Inherit: Inherit via internal rule	[]	[]	Inherit: Same as first input

Table 45. Trigonometry Block Properties

Name	Operator	Approximation Method	Number Of Iterations	Output Signal Type
tangent	atan	None	11	auto

System - landing/Aircraft Subsystem/Guidance System/Guide to Glideslope

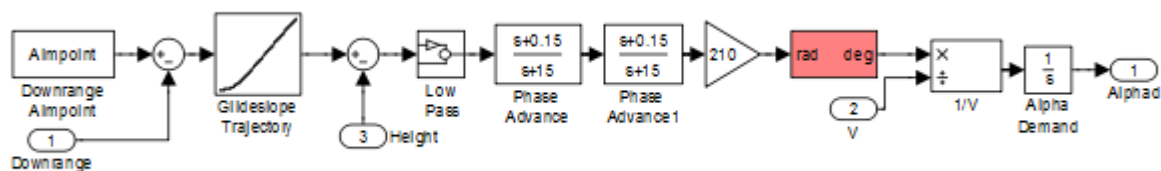


Table 46. Angle Conversion Block Properties

Name	IU	OU
Angle Conversion	rad	deg

Table 47. Constant Block Properties

Name	Value	Sampling Mode	Out Min	Out Max	Out Data Type Str	Sample Time	Frame Period
Downrange Aimpoint	Aimpoint	Sample based	[]	[]	Inherit: Inherit from 'Constant value'	inf	inf

Table 48. Gain Block Properties

Name	Gain	Multiplication	Param Min	Param Max	Param Data Type Str	Out Min	Out Max	Out Data Type Str
Gain4	210	Element-wise(K.*u)	[]	[]	Inherit: Same as input	[]	[]	Inherit: Same as input

Table 49. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
Downrange	1	Demux	[]	[]
Height	3	height	[]	[]
V	2	V	[]	[]

Table 50. Integrator Block Properties

Name	External Reset	Initial Condition Source	Initial Condition	Zero Cross	Continuous State Attributes
Alpha Demand	none	internal	alpha0*180/pi	on	"

Table 51. Lookup Block Properties

Name	Input Values	Table	Look Up Meth	Out Min	Out Max	Out Data Type Str
Glideslope Trajectory	Xglide	hglide	Interpolation-Extrapolation	[]	[]	Inherit: Same as input

Table 52. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Size Sig	Out Min	Out Max	Out Data Type Str	Source Of Initial Output Value	Output When Disabled	Initial Output	Used By Blk
Alphad	1	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Flare Switch

Table 53. Product Block Properties

Name	Inputs	Multiplication	Collapse Mode	Collapse Dim	Input Same DT	Out Min	Out Max	Out Data Type Str
1/V	*/	Element-wise(.*)	All dimensions	1	on	[]	[]	Inherit: Same as first input

Table 54. Sum Block Properties

Name	Icon Shape	Inputs	Collapse Mode	Collapse Dim	Input Same DT	Accum Data Type Str	Out Min	Out Max	Out Data Type Str
Sum1	round	+-	All dimensions	1	on	Inherit: Inherit via internal rule	[]	[]	Inherit: Same as first input
Sum2	round	+-	All dimensions	1	on	Inherit: Inherit via internal rule	[]	[]	Inherit: Same as first input

Table 55. TransferFcn Block Properties

Name	Numerator	Denominator	Continuous State Attributes
Phase Advance	[1 0.15]	[1 15]	"
Phase Advance1	[1 0.15]	[1 15]	"

System - landing/Aircraft Subsystem/Guidance System/Guide to Glideslope/Low Pass

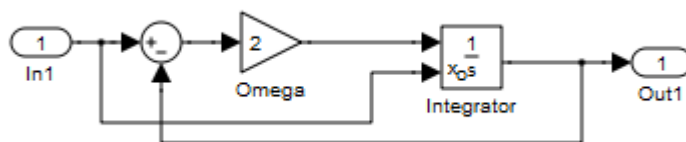


Table 56. Gain Block Properties

Name	Gain	Multiplication	Param Min	Param Max	Param Data Type Str	Out Min	Out Max	Out Data Type Str
Omega	2	Element-wise(K.*u)	[]	[]	Inherit: Same as input	[]	[]	Inherit: Same as input

Table 57. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
In1	1	Sum2	[]	[]

Table 58. Integrator Block Properties

Name	External Reset	Initial Condition Source	Zero Cross	Continuous State Attributes
Integrator	none	external	on	"

Table 59. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Size	Size	Out Min	Out Max	Out Data Type Str	Source Of Initial Output Value	Output When Disabled	Initial Output	Used By Blk
Out1	1	Port number	BusObject	Inherit	[]	[]	[]	Inherit: auto	Dialog	held	[]	Phase Advance, Sum3

Table 60. Sum Block Properties

Name	Icon Shape	Inputs	Collapse Mode	Collapse Dim	Input Same DT	Accum Data Type Str	Data Type	Out Min	Out Max	Out Data Type Str
Sum3	round	+ -	All dimensions	1	on	Inherit: Inherit via internal rule		[]	[]	Inherit: Same as first input

System - landing/Aircraft Subsystem/Guidance System/Scopes

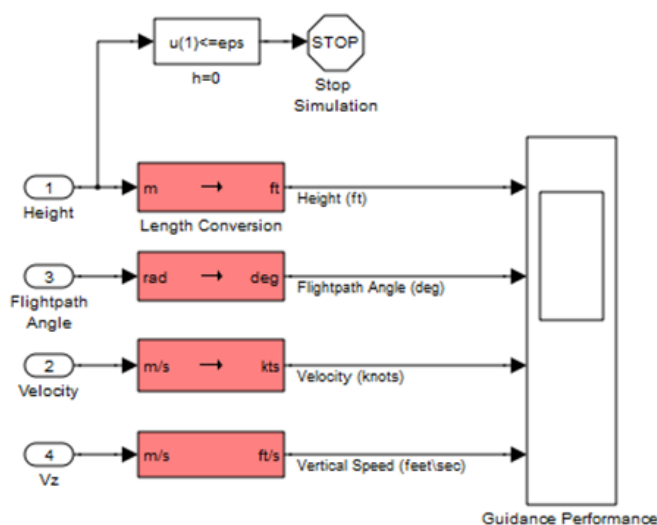


Table 61. Angle Conversion Block Properties

Name	IU	OU
Angle Conversion	rad	deg

Table 62.Fcn Block Properties

Name	Expr
h=0	u(1)<=eps

Table 63. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
Flightpath Angle	3	<u>tangent</u>	[]	[]
Height	1	<u>height</u>	[]	[]
Velocity	2	<u>V</u>	[]	[]
Vz	4	<u>Selector</u>	[]	[]

Table 64. Length Conversion Block Properties

Name	IU	OU
Length Conversion	m	ft

Table 65. Stop Block Properties

Name
Stop Simulation

Table 66. Velocity Conversion Block Properties

Name	IU	OU
V2	m/s	kts
Velocity Conversion	m/s	ft/s

System - landing/Aircraft Subsystem/IMU,GPS & Radar Altimeter

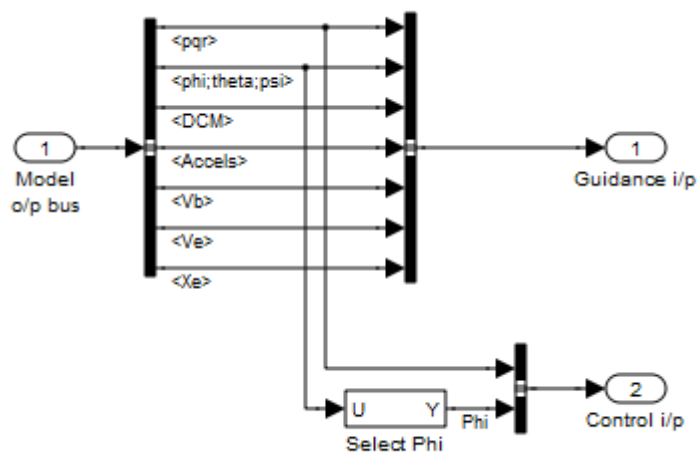


Table 67. BusCreator Block Properties

Name	Inputs	Display Option	Bus Object	Non Virtual Bus
Bus Creator	7	bar	BusObject	off
Bus Creator1	2	bar	BusObject	off

Table 68. BusSelector Block Properties

Name	Output Signals	Output As Bus	Input Signals
Bus Selector	pqr,phi;theta;psi,DCM,Accels,Vb,Ve,Xe	off	pdot;qdot;rdot pqr phi;theta;psi DCM Accels Vb Ve Xe { Alpha;Beta , Alpha Beta } Mach qbar

Table 69. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
Model bus	o/p 1	Reshape, p,q,r , phi theta psi, Reshape (9) to [3x3] column-major, Force ---> Acc, Unit Conversion, Unit Conversion, xe,ye,ze, Incidence, Sideslip, Product1, 1/2rhoV^2	[]	[]

Table 70. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Size	Out Min	Out Max	Out Data Type Str	Source Of Initial Output Value	Output When Disabled	Initial Output	Used By Blk
Control i/p	2	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Sum2, Sum1
Guidance i/p	1	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Demux, u,v,w, Dot Product, Selector

Table 71. Selector Block Properties

Name	Number Of Dimensions	Index Mode	Index Array	Option	Index Param Array	Output Array	Size	Input Port Width	Index Options	Indices	Output Sizes
Select Phi	1	One-based	Index vector (dialog)	vector	[1]	1	3	3	Index vector (dialog)	[1]	1

System - landing/Control System

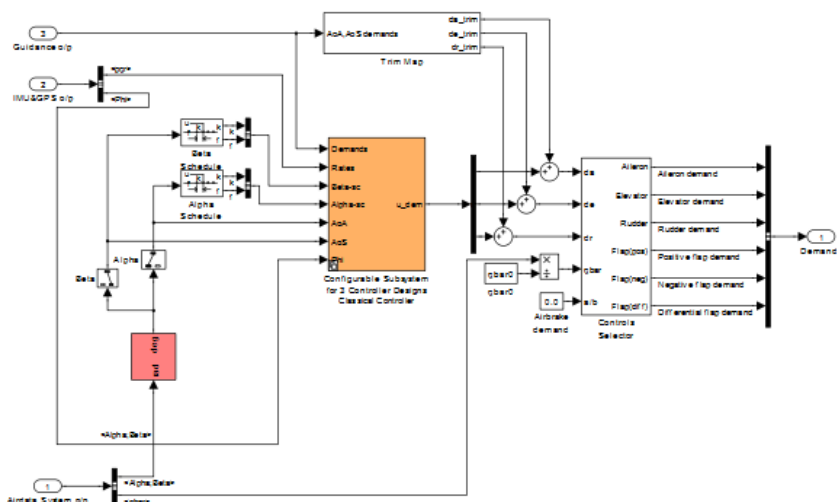


Table 72. Angle Conversion Block Properties

Name	IU	OU
Angle Conversion	rad	deg

Table 73. BusCreator Block Properties

Name	Inputs	Display Option	Bus Object	Non Virtual Bus
Bus Creator	2	bar	BusObject	off
Bus Creator1	6	bar	BusObject	off
Bus Creator2	2	bar	BusObject	off

Table 74. BusSelector Block Properties

Name	Output Signals	Output As Bus	Input Signals
Bus Selector	pqr,Phi	off	pqr Phi
Bus Selector1	Alpha;Beta,qbar	off	{ Alpha;Beta , Alpha Beta } qbar

Table 75. Constant Block Properties

Name	Value	Sampling Mode	Out Min	Out Max	Out Data Type Str	Sample Time	Frame Period
Airbrake demand	0.0	Sample based	[]	[]	Inherit: Inherit from 'Constant value'	inf	inf
qbar0	qbar0	Sample based	[]	[]	Inherit: Inherit from 'Constant value'	inf	inf

Table 76. Demux Block Properties

Name	Outputs	Display Option	Bus Selection Mode
Demux1	3	none	off

Table 77. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
Airdata System o/p	1	Incidence, Sideslip, $1/2\rho V^2$	[]	[]
Guidance o/p	3	<u>Limit Demands</u>	[]	[]
IMU&GPS o/p	2	p,q,r , <u>Select Phi</u>	[]	[]

Table 78. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Size	Out Min	Out Max	Out Data Type Str	Source Of Initial Output Value	Output When Disabled	Initial Output	Used By Blk
Demands	1	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	<u>Aero2Act</u>

Table 79. PreLookup Block Properties

Name	Breakpoints Data	Index Search Method	Begin Index Search Using Previous Index Result	Output Only The Index	Process Out Of Range Input	Use Last Breakpoint	Action For Out Of Range Input	Breakpoint Min	Breakpoint Max	Breakpoint Data Type Str	Index Data Type Str	Fraction Data Type Str
Alpha Schedule	a_vec	Binary search	on	off	Linear extrapolation	off	None	[]	[]	Inherit: Same input	as uint32	Inherit: Inherit via internal rule
Beta Schedule	b_vec	Binary search	on	off	Linear extrapolation	off	None	[]	[]	Inherit: Same input	as uint32	Inherit: Inherit via internal rule

Table 80. Product Block Properties

Name	Inputs	Multiplication	Collapse Mode	Collapse Dim	Input Same DT	Out Min	Out Max	Out Data Type Str
Product1	*/	Element-wise(.*)	All dimensions	1	on	[]	[]	Inherit: Same as first input

Table 81. 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
Alpha	1	One-based	Index vector (dialog)	1	1	2	Index vector (dialog)	1	1
Beta	1	One-based	Index vector (dialog)	2	1	2	Index vector (dialog)	2	1

Table 82. Sum Block Properties

Name	Icon Shape	Inputs	Collapse Mode	Collapse Dim	Input Same DT	Accum Data Type Str	Out Min	Out Max	Out Data Type Str
Sum1	round	++	All dimensions	1	on	Inherit: Inherit via internal rule	[]	[]	Inherit: Same as first input
Sum2	round	++	All dimensions	1	on	Inherit: Inherit via internal rule	[]	[]	Inherit: Same as first input
Sum3	round	++	All dimensions	1	on	Inherit: Inherit via internal rule	[]	[]	Inherit: Same as first input

System - landing/Control System/Configurable Subsystem for 3 Controller Designs

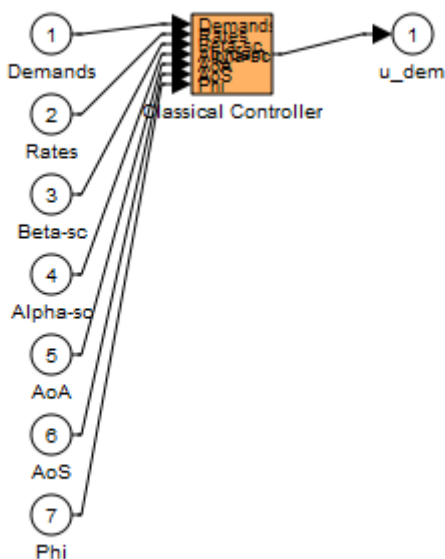


Table 83. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
Alpha-sc	4	Alpha Schedule , Alpha Schedule	[]	[]
AoA	5	Alpha	[]	[]
AoS	6	Beta	[]	[]
Beta-sc	3	Beta Schedule , Beta Schedule	[]	[]
Demands	1	Limit Demands	[]	[]
Phi	7	Select Phi	[]	[]
Rates	2	p,q,r	[]	[]

Table 84. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Sig	Size	Out Min	Out Max	Out Data Type Str	Source Initial Output Value	Of Output When Disabled	Initial Output	Used By Blk
u_dem	1	Port number	BusObject	Inherit	[]	[]		Inherit: auto	Dialog	held	[]	Demux1

System - landing/Control System/Trim Map

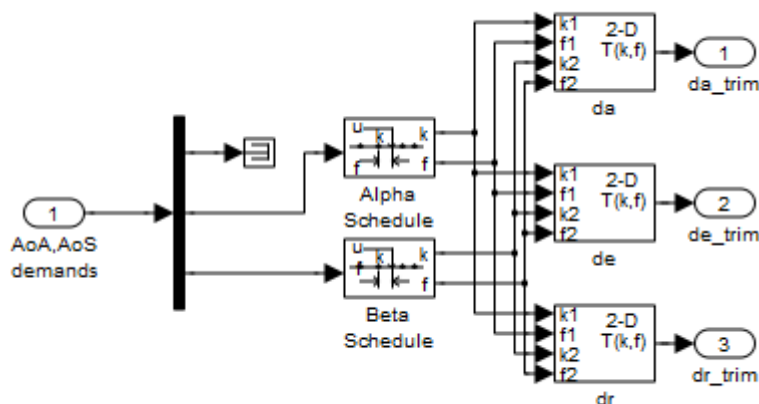


Table 85. Demux Block Properties

Name	Outputs	Display Option	Bus Selection Mode
Demux	3	none	off

Table 86. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
AoA,AoS demands	1	Limit Demands	[]	[]

Table 87. Interpolation_n-D Block Properties

Name	Number Of Table Dimensions	Table	Interp Method	Extra p Method	Range Error Mode	Check Index In Code	Valid Index May Reach Last	Num Selection Dims	Out Min	Out Max	Out Data Type Str	Table Min	Table Max	Table Data Type Str	Intermediate Results Data Type Str
da	2	squeeze(U_trim_matrix(1,:,:))	Linear	Linear	None	off	off	0	[]	[]	Inherit: Inherit from 'Table data'	[]	[]	Inherit: Same as output	Inherit: Same as output
de	2	squeeze(U_trim_matrix(2,:,:))	Linear	Linear	None	off	off	0	[]	[]	Inherit: Inherit from 'Table data'	[]	[]	Inherit: Same as output	Inherit: Same as output

Name	Number Of Table Dimensions	Table	Interp Method	Extra p Method	Range Error Mode	Check Index Code	Valid Index May Reach Last	Num Selection Dims	Out Min	Out Max	Out Data Type Str	Table Min	Table Max	Table Data Type Str	Intermediate Results Data Type Str
dr	2	squeeze(U_trim_matrix(3,,:))	Linear	Linear	None	off	off	0	[]	[]	Inherit: Inherit from 'Table data'	[]	[]	Inherit: Same as output	Inherit: Same as output

Table 88. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Sig	Size	Out Min	Out Max	Out Data Type Str	Source Initial Output Value	Of Output When Disabled	Initial Output	Used By Blk
da_trim	1	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Sum2	
de_trim	2	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Sum1	
dr_trim	3	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Sum3	

Table 89. PreLookup Block Properties

Name	Breakpoints Data	Index Search Method	Begin Index Search Using Previous Index Result	Output Only The Index	Process Out Of Range Input	Use Last Breakpoint	Action For Out Of Range Input	Breakpoint Min	Breakpoint Max	Breakpoint Data Type Str	Index Data Type Str	Fraction Data Type Str
Alpha Schedule	a_vec	Binary search	on	off	Linear extrapolation	off	None	[]	[]	Inherit: Same input	as uint32	Inherit: Inherit via internal rule
Beta Schedule	b_vec	Binary search	on	off	Linear extrapolation	off	None	[]	[]	Inherit: Same input	as uint32	Inherit: Inherit via internal rule

Table 90. Terminator Block Properties

Name
Terminator

System - landing/Scopes

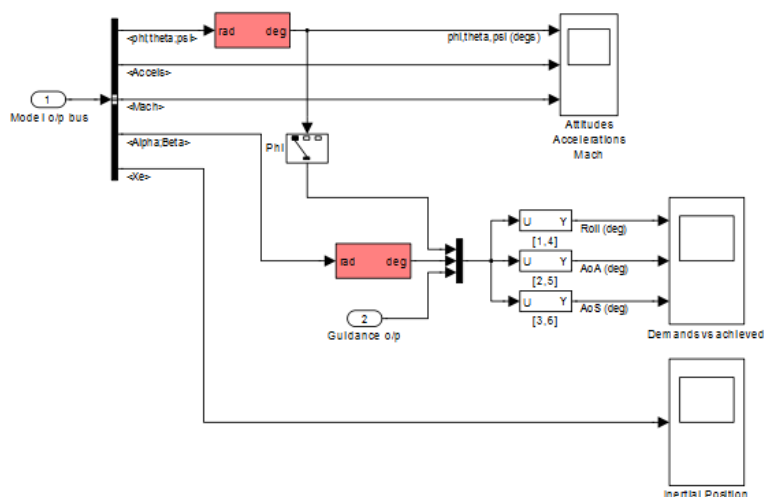


Table 91. Angle Conversion Block Properties

Name	IU	OU
Angle Conversion	rad	deg
Angle Conversion3	rad	deg

Table 92. BusSelector Block Properties

Name	Output Signals	Output As Bus	Input Signals
Bus Selector	phi;theta;psi,Accels,Mach,Alpha;Beta,Xe	off	pdot;qdot;rdot pqr phi;theta;psi DCM Accels Vb Ve Xe { Alpha;Beta , Alpha Beta } Mach qbar

Table 93. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
Guidance o/p	2	Limit Demands	[]	[]
Model o/p bus	1	Reshape, p,q,r , phi theta psi, Reshape (9) to [3x3] column-major, Force ---> Acc, Unit Conversion, Unit Conversion, xe,ye,ze, Incidence, Sideslip, Product1, 1/2rhoV^2	[]	[]

Table 94. Mux Block Properties

Name	Inputs	Display Option
Mux	[1,2,3]	bar

Table 95. Selector Block Properties

Name	Number Dimensions	Of	Index Mode	Index Option Array	Index Param Array	Output Size Array	Input Port Width	Index Options	Indices	Output Sizes
[1,4]	1		One-based	Index vector (dialog)	[1 4]	1	6	Index vector (dialog)	[1 4]	1
[2,5]	1		One-based	Index vector (dialog)	[2 5]	1	6	Index vector (dialog)	[2 5]	1

Name	Number Dimensions	Of Index Mode	Index Option Array	Index Param Array	Output Size Array	Input Port Width	Index Options	Indices	Output Sizes
[3,6]	1	One-based	Index vector (dialog)	[3 6]	1	6	Index vector (dialog)	[3 6]	1
Phi	1	One-based	Index vector (dialog)	1	1	3	Index vector (dialog)	1	1

System - landing/Visualization

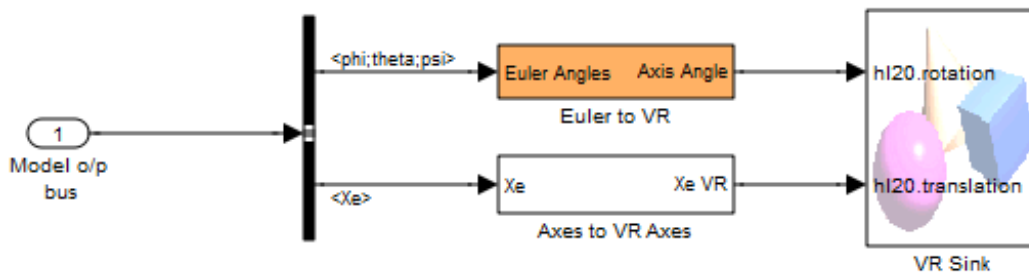


Table 96. BusSelector Block Properties

Name	Output Signals	Output As Bus	Input Signals
Bus Selector	phi;theta;psi,Xe	off	pdot;qdot;rdot pqr phi;theta;psi DCM Accels Vb Ve Xe { Alpha;Beta , Alpha Beta } Mach qbar

Table 97. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
Model o/p bus	1	Reshape, p,q,r , phi theta psi, Reshape (9) to [3x3] column-major, Force ---> Acc, Unit Conversion, Unit Conversion, xe,ye,ze, Incidence, Sideslip, Product1, 1/2rhoV^2	[]	[]

Table 98. Virtual Reality Sink Block Properties

Name	Sample Time	View Enable	Remote View	Fields Written	World File Name	World Description	Auto View	Video Dimensions
VR Sink	0.1	on	off	h120.rotation.4#h120.translation.3	aeroblk_HL20.wrl	aeroblk_HL20	on	[]

System - landing/Visualization/Axes to VR Axes

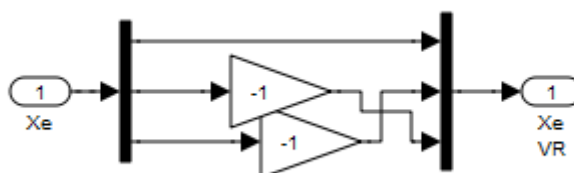


Table 99. Demux Block Properties

Name	Outputs	Display Option	Bus Selection Mode
Demux	3	none	off

Table 100. Gain Block Properties

Name	Gain	Multiplication	Param Min	Param Max	Param Data Type Str	Out Min	Out Max	Out Data Type Str
rad-->deg	-1	Element-wise(K.*u)	[]	[]	Inherit: Same as input	[]	[]	Inherit: Same as input
rad-->deg1	-1	Element-wise(K.*u)	[]	[]	Inherit: Same as input	[]	[]	Inherit: Same as input

Table 101. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
Xe	1	xe,ye,ze	[]	[]

Table 102. Mux Block Properties

Name	Inputs	Display Option
Mux	3	bar

Table 103. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Size	Out Min	Out Max	Out Data Type Str	Source Initial Output Value	Of Output When Disabled	Initial Output	Used By Blk
Xe VR	1	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	VR Sink

System - landing/Visualization/Euler to VR

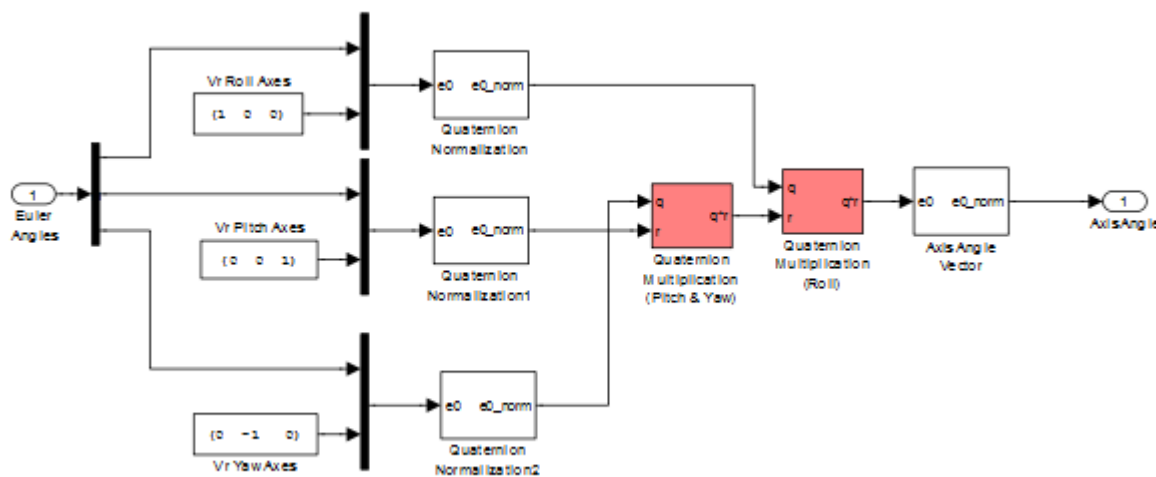


Table 104. Constant Block Properties

Name	Value	Sampling Mode	Out Min	Out Max	Out Data Type Str	Sample Time	Frame Period
Vr Pitch Axes	[0 0 1]	Sample based	[]	[]	Inherit: Inherit from 'Constant value'	inf	inf
Vr Roll Axes	[1 0 0]	Sample based	[]	[]	Inherit: Inherit from 'Constant value'	inf	inf
Vr Yaw Axes	[0 -1 0]	Sample based	[]	[]	Inherit: Inherit from 'Constant value'	inf	inf

Table 105. Demux Block Properties

Name	Outputs	Display Option	Bus Selection Mode
Demux	3	none	off

Table 106. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
Euler Angles	1	phi theta psi	[]	[]

Table 107. Mux Block Properties

Name	Inputs	Display Option
Mux	2	bar
Mux1	2	bar
Mux2	2	bar

Table 108. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Size	Out Min	Out Max	Out Data Type Str	Source Initial Output Value	Of	Output When Disabled	Initial Output	Used By Blk
Axis Angle	1	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog		held	[]	VR Sink

Table 109. Quaternion Multiplication Block Properties

Name
Quaternion Multiplication (Pitch & Yaw)
Quaternion Multiplication (Roll)

System - landing/Visualization/Euler to VR/Axis Angle Vector

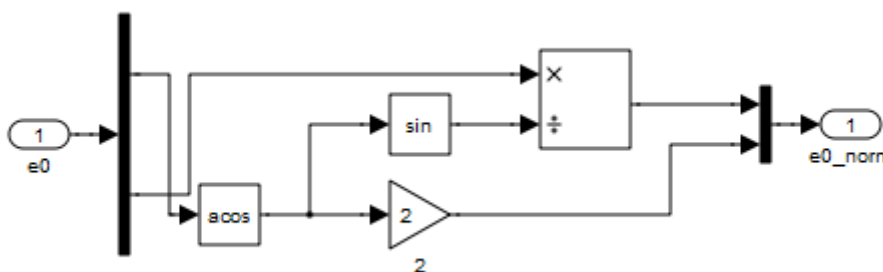


Table 110. Demux Block Properties

Name	Outputs	Display Option	Bus Selection Mode
Demux	[1 3]	none	off

Table 111. Gain Block Properties

Name	Gain	Multiplication	Param Min	Param Max	Param Data Type Str	Out Min	Out Max	Out Data Type Str
2	2	Element-wise(K.*u)	[]	[]	Inherit: Same as input	[]	[]	Inherit: Same as input

Table 112. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
e0	1	Sum, Sum, Sum, Sum	[]	[]

Table 113. Mux Block Properties

Name	Inputs	Display Option
Mux	2	bar

Table 114. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Size	Size	Out Min	Out Max	Out Data Type Str	Source Initial Output Value	Of Output When Disabled	Initial Output	Used By Blk
e0_norm	1	Port number	BusObject	Inherit	[]	[]	[]	Inherit: auto	Dialog	held	[]	VR Sink

Table 115. Product Block Properties

Name	Inputs	Multiplication	Collapse Mode	Collapse Dim	Input Same DT	Out Min	Out Max	Out Data Type Str
Product	*/	Element-wise(.*)	All dimensions	1	on	[]	[]	Inherit: Same as first input

Table 116. Trigonometry Block Properties

Name	Operator	Approximation Method	Number Of Iterations	Output Signal Type
Trigonometric Function	sin	None	11	auto
Trigonometric Function2	acos	None	11	auto

System - landing/Visualization/Euler to VR/Quaternion Normalization

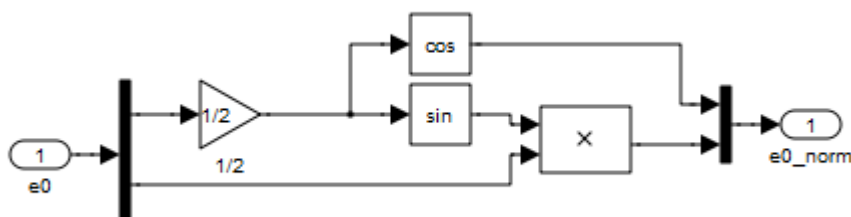


Table 117. Demux Block Properties

Name	Outputs	Display Option	Bus Selection Mode
Demux	[1 3]	none	off

Table 118. Gain Block Properties

Name	Gain	Multiplication	Param Min	Param Max	Param Data Type Str	Out Min	Out Max	Out Data Type Str
1/2	1/2	Element-wise(K.*u)	[]	[]	Inherit: Same as input	[]	[]	Inherit: Same as input

Table 119. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
e0	1	Demux, Vr Roll Axes	[]	[]

Table 120. Mux Block Properties

Name	Inputs	Display Option
Mux	2	bar

Table 121. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Size	Size	Out Min	Out Max	Out Data Type Str	Source Initial Output Value	Of Output When Disabled	Initial Output	Used By Blk
e0_norm	1	Port number	BusObject	Inherit	[]	[]	[]	Inherit: auto	Dialog	held	[]	Demux, Demux, Demux, Demux

Table 122. Product Block Properties

Name	Inputs	Multiplication	Collapse Mode	Collapse Dim	Input Same DT	Out Min	Out Max	Out Data Type Str
Product	2	Element-wise(.*)	All dimensions	1	on	[]	[]	Inherit: Same as first input

Table 123. Trigonometry Block Properties

Name	Operator	Approximation Method	Number Of Iterations	Output Signal Type
Trigonometric Function	sin	None	11	auto
Trigonometric Function1	cos	None	11	auto

System - landing/Visualization/Euler to VR/Quaternion Normalization1

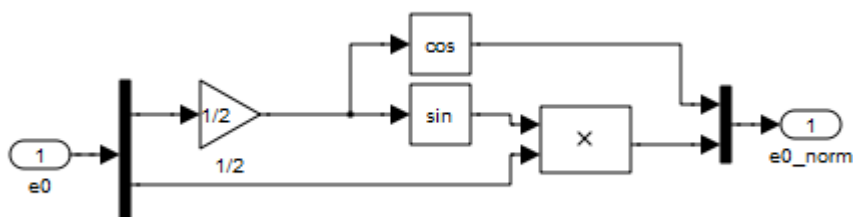


Table 124. Demux Block Properties

Name	Outputs	Display Option	Bus Selection Mode
Demux	[1 3]	none	off

Table 125. Gain Block Properties

Name	Gain	Multiplication	Param Min	Param Max	Param Data Type Str	Out Min	Out Max	Out Data Type Str
1/2	1/2	Element-wise(K.*u)	[]	[]	Inherit: Same as input	[]	[]	Inherit: Same as input

Table 126. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
e0	1	Demux, Vr Pitch Axes	[]	[]

Table 127. Mux Block Properties

Name	Inputs	Display Option
Mux	2	bar

Table 128. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Size Sig	Out Min	Out Max	Out Data Type Str	Source Initial Output Value	Output When Disabled	Initial Output	Used By Blk
e0_norm	1	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Demux1, Demux1, Demux1, Demux1

Table 129. Product Block Properties

Name	Inputs	Multiplication	Collapse Mode	Collapse Dim	Input Same DT	Out Min	Out Max	Out Data Type Str
Product	2	Element-wise(.*)	All dimensions	1	on	[]	[]	Inherit: Same as first input

Table 130. Trigonometry Block Properties

Name	Operator	Approximation Method	Number Of Iterations	Output Signal Type
Trigonometric Function	sin	None	11	auto
Trigonometric Function1	cos	None	11	auto

System - landing/Visualization/Euler to VR/Quaternion Normalization2

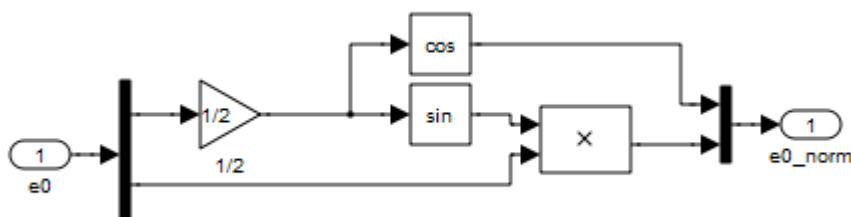


Table 131. Demux Block Properties

Name	Outputs	Display Option	Bus Selection Mode
Demux	[1 3]	none	off

Table 132. Gain Block Properties

Name	Gain	Multiplication	Param Min	Param Max	Param Data Type Str	Out Min	Out Max	Out Data Type Str
1/2	1/2	Element-wise(K.*u)	[]	[]	Inherit: Same as input	[]	[]	Inherit: Same as input

Table 133. Inport Block Properties

Name	Port	Defined In Blk	Out Min	Out Max
e0	1	Demux, Vr Yaw Axes	[]	[]

Table 134. Mux Block Properties

Name	Inputs	Display Option
Mux	2	bar

Table 135. Outport Block Properties

Name	Port	Icon Display	Bus Object	Var Size	Out Min	Out Max	Out Data Type Str	Source Initial Output Value	Of Output When Disabled	Initial Output	Used By Blk
e0_norm	1	Port number	BusObject	Inherit	[]	[]	Inherit: auto	Dialog	held	[]	Demux, Demux, Demux, Demux

Table 136. Product Block Properties

Name	Inputs	Multiplication	Collapse Mode	Collapse Dim	Input Same DT	Out Min	Out Max	Out Data Type Str
Product	2	Element-wise(.*)	All dimensions	1	on	[]	[]	Inherit: Same as first input

Table 137. Trigonometry Block Properties

Name	Operator	Approximation Method	Number Of Iterations	Output Signal Type
Trigonometric Function	sin	None	11	auto
Trigonometric Function1	cos	None	11	auto

Appendix

Table 138. Revision History

Ver	Date	Description
1.0	Wed Mar 13 13:42:21 2002	

Table 139. Block Type Count

BlockType	Count	Block Names
Inport	36	<u>Demands</u> , <u>Model o/p bus</u> , <u>In1</u> , <u>Ve</u> , <u>Downrange</u> , <u>Height</u> , <u>In1</u> , <u>V</u> , <u>IMU/GPS o/p</u> , <u>Flightpath Angle</u> , <u>Height</u> , <u>Velocity</u> , <u>Vz</u> , <u>Model o/p bus</u> , <u>In1</u> , <u>In2</u> , <u>Airdata System o/p</u> , <u>Alpha-sc</u> , <u>AoA</u> , <u>AoS</u> , <u>Beta-sc</u> , <u>Demands</u> , <u>Phi</u> , <u>Rates</u> , <u>Guidance o/p</u> , <u>IMU&GPS o/p</u> , <u>AoA.AoS demands</u> , <u>Guidance o/p</u> , <u>Model o/p bus</u> , <u>Xe</u> , <u>e0</u> , <u>Euler Angles</u> , <u>e0</u> , <u>e0</u> , <u>e0</u> , <u>Model o/p bus</u>
SubSystem	24	<u>Actuators</u> , <u>Aircraft Subsystem</u> , <u>Airdata System</u> , <u>Guidance System</u> , <u>Flare</u> , <u>Flightpath Angle</u> , <u>Guide to Glideslope</u> , <u>Low Pass</u> , <u>Scopes</u> , <u>HL20 Airframe</u> , <u>IMU,GPS & Radar Altimeter</u> , <u>Control System</u> , <u>Configurable Subsystem for 3 Controller Designs</u> , <u>Classical Controller</u> , <u>Controls Selector</u> , <u>Trim Map</u> , <u>Scopes</u> , <u>Visualization</u> , <u>Axes to VR Axes</u> , <u>Euler to VR</u> , <u>Axis Angle Vector</u> , <u>Quaternion Normalization</u> , <u>Quaternion Normalization1</u> , <u>Quaternion Normalization2</u>
Outport	24	<u>Positions</u> , <u>Control i/p</u> , <u>Control i/p</u> , <u>Out1</u> , <u>gamma</u> , <u>Alphad</u> , <u>Out1</u> , <u>Control i/p</u> , <u>Guidance i/p</u> , <u>Out1</u> , <u>Out2</u> , <u>Out3</u> , <u>Out4</u> , <u>u dem</u> , <u>Demands</u> , <u>da trim</u> , <u>de trim</u> , <u>dr trim</u> , <u>Xe VR</u> , <u>Axis Angle</u> , <u>e0 norm</u> , <u>e0 norm</u> , <u>e0 norm</u> , <u>e0 norm</u>
Gain	13	<u>Act2Aero</u> , <u>Aero2Act</u> , <u>Gain1</u> , <u>rad-->deg4</u> , <u>Gain4</u> , <u>Omega</u> , <u>height</u> , <u>rad-->deg</u> , <u>rad-->deg1</u> , <u>2</u> , <u>1/2</u> , <u>1/2</u> , <u>1/2</u>
Selector	10	<u>u.v</u> , <u>w</u> , <u>Selector</u> , <u>Select Phi</u> , <u>Alpha</u> , <u>Beta</u> , <u>Phi</u> , <u>[1.4]</u> , <u>[2.5]</u> , <u>[3.6]</u>
Mux	10	<u>Mux</u> , <u>Mux</u> , <u>Mux</u> , <u>Mux</u> , <u>Mux</u> , <u>Mux1</u> , <u>Mux2</u> , <u>Mux</u> , <u>Mux</u> , <u>Mux</u>
Demux	10	<u>Demux</u> , <u>Demux</u> , <u>Demux1</u> , <u>Demux</u> , <u>Demux</u> , <u>Demux</u> , <u>Demux</u> , <u>Demux</u> , <u>Demux</u> , <u>Demux</u>
Trigonometry	9	<u>tangent</u> , <u>Trigonometric Function</u> , <u>Trigonometric Function2</u> , <u>Trigonometric Function</u> , <u>Trigonometric Function1</u> , <u>Trigonometric Function</u> , <u>Trigonometric Function1</u> , <u>Trigonometric Function</u> , <u>Trigonometric Function1</u>
Constant	9	<u>Flare Demand1</u> , <u>Downrange Aimpoint</u> , <u>Phi Beta</u> , <u>Airbrake demand</u> , <u>qbar0</u> , <u>Thrust</u> , <u>Vr Pitch Axes</u> , <u>Vr Roll Axes</u> , <u>Vr Yaw Axes</u>
Sum	8	<u>Sum2</u> , <u>Sum2</u> , <u>Sum3</u> , <u>Sum1</u> , <u>Sum2</u> , <u>Sum1</u> , <u>Sum2</u> , <u>Sum3</u>
Product	8	<u>product</u> , <u>product1</u> , <u>1/V</u> , <u>Product1</u> , <u>Product</u> , <u>Product</u> , <u>Product</u> , <u>Product</u>
BusCreator	8	<u>Bus Creator1</u> , <u>Bus Creator1</u> , <u>Bus Creator</u> , <u>Bus Creator1</u> , <u>Model o/p bus</u> , <u>Bus Creator</u> , <u>Bus Creator1</u> , <u>Bus Creator2</u>
BusSelector	7	<u>Bus Selector</u> , <u>Bus Selector</u> , <u>Bus Selector</u> , <u>Bus Selector</u> , <u>Bus Selector1</u> , <u>Bus Selector</u> , <u>Bus Selector</u>
Scope	5	<u>Guidance Performance</u> , <u>Limited Actuators</u> , <u>Attitudes Accelerations Mach</u> , <u>Demands vs achieved</u> , <u>Inertial Position</u>
Angle Conversion (m)	5	<u>Angle Conversion</u> , <u>Angle Conversion</u> , <u>Angle Conversion</u> , <u>Angle Conversion</u> , <u>Angle Conversion3</u>
PreLookup	4	<u>Alpha Schedule</u> , <u>Beta Schedule</u> , <u>Alpha Schedule</u> , <u>Beta Schedule</u>
Interpolation_n-D	3	<u>da</u> , <u>de</u> , <u>dr</u>
Integrator	3	<u>Alphad1</u> , <u>Alpha Demand</u> , <u>Integrator</u>
Velocity Conversion (m)	2	<u>V2</u> , <u>Velocity Conversion</u>
TransferFcn	2	<u>Phase Advance</u> , <u>Phase Advance1</u>
Terminator	2	<u>Terminator</u> , <u>Terminator</u>
Quaternion Multiplication (m)	2	<u>Quaternion Multiplication (Pitch & Yaw)</u> , <u>Quaternion Multiplication (Roll)</u>
Math	2	<u>y</u> , <u>V</u>
Virtual Reality Sink (m)	1	<u>VR Sink</u>
UnitDelay	1	<u>Unit Delay</u>
Switch	1	<u>Flare Switch</u>
Stop	1	<u>Stop Simulation</u>
Second Order Nonlinear Actuator (m)	1	<u>Second Order Nonlinear Actuator</u>
Saturate	1	<u>Limit Demands</u>
Lookup	1	<u>Glideslope Trajectory</u>
Logic	1	<u>Logical Operator</u>
Length Conversion (m)	1	<u>Length Conversion</u>
Fcn	1	<u>h=0</u>
EnablePort	1	<u>Enable</u>
DotProduct	1	<u>Dot Product</u>
Compare To Constant (m)	1	<u>Flare Condition</u>

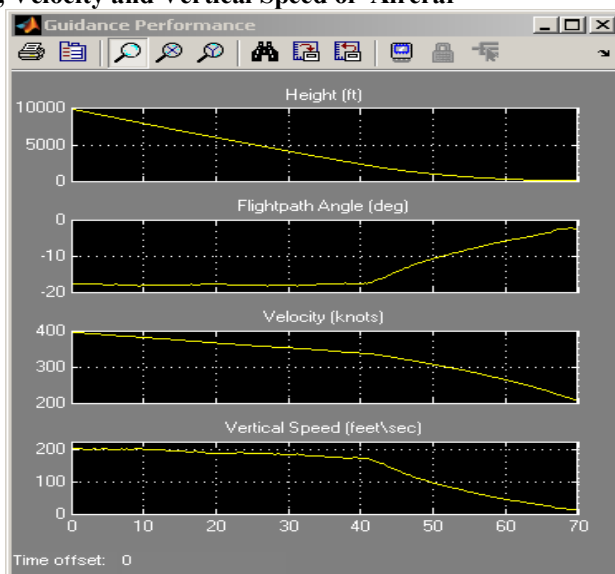
Table 140. Model Variables

Variable Name	Parent Blocks	Calling string	Value
Act2Aero	<u>Act2Aero</u>	Act2Aero	[0.5 -0.5 0 0 0 0 ; 0.5 0.5 0 0 0 0 ; 0 0 0 0 0 1 ; 0 0 0.5 0.5 0 0 ; 0 0 0 0.5 0.5 0 ; 0 0 0.5 -0.5 0.5 -0.5 0]
Aero2Act	<u>Aero2Act</u>	Aero2Act	[1 1 0 0 0 0 ; -1 1 0 0 0 0 ; 0 0 0 1 -1.1102e-016 0.5 ; 0 0 0 1 1.1102e-016 -0.5 ; 0 0 0 0 1 0.5 ; 0 0 0 0 1 -0.5 ; 0 0 1 0 0 0]
Aimpoint	<u>Downrange Aimpoint</u>	Aimpoint	0
U_trim_matrix	<u>da</u> <u>de</u> <u>dr</u>	squeeze(U_trim_matrix(1,,:)) squeeze(U_trim_matrix(2,,:)) squeeze(U_trim_matrix(3,,:))	[3x8x5 double]
Xglide	<u>Glideslope Trajectory</u>	Xglide	[1x301 double]
a_vec	<u>Alpha Schedule</u> <u>Alpha Schedule</u>	a_vec a_vec	[-9.9 -5 0.01 5 10 15 20 25]
alpha0	<u>Alpha Demand</u>	alpha0*180/pi	0.1143
b_vec	<u>Beta Schedule</u> <u>Beta Schedule</u>	b_vec b_vec	[-9.9 -5 0.01 5 9.9]
hglide	<u>Glideslope Trajectory</u>	hglide	[1x301 double]
max_lim	Second Order Nonlinear Actuator	max_lim	[30 30 60 60 0 0 60]
min_lim	Second Order Nonlinear Actuator	min_lim	[-30 -30 0 0 -60 -60 -60]
qbar0	<u>qbar0</u>	qbar0	1.0723e+004
wn_act	Second Order Nonlinear Actuator	wn_act	44
z_act	Second Order Nonlinear Actuator	z_act	0.7071

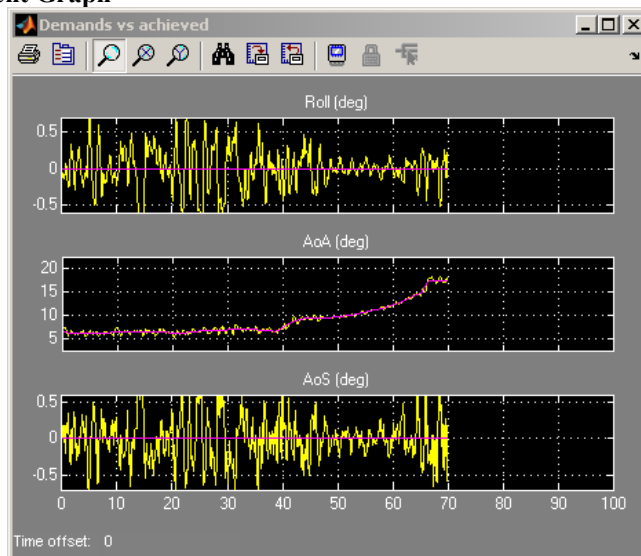
Table 141. Model Functions

Function Name	Parent Blocks	Calling string
pi	<u>Alpha Demand</u>	alpha0*180/pi
squeeze	<u>da</u> <u>de</u> <u>dr</u>	squeeze(U_trim_matrix(1,,:)) squeeze(U_trim_matrix(2,,:)) squeeze(U_trim_matrix(3,,:))

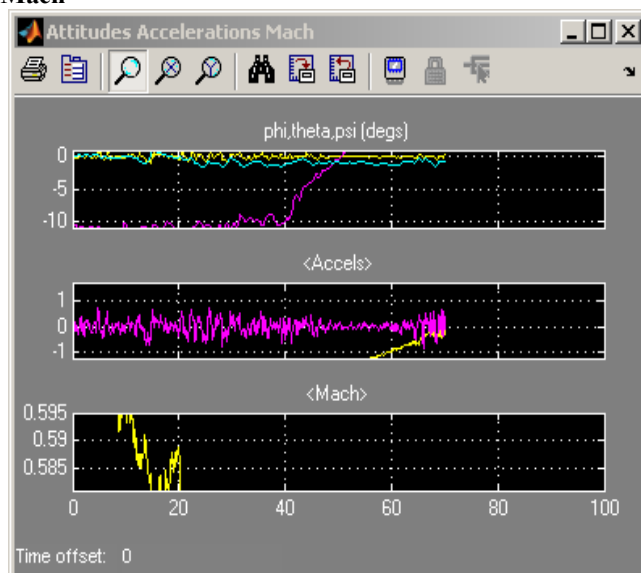
IV. Result Of Simulation On Landing Stage Height, Flightpath Angle, Velocity and Vertical Speed of Aircraft



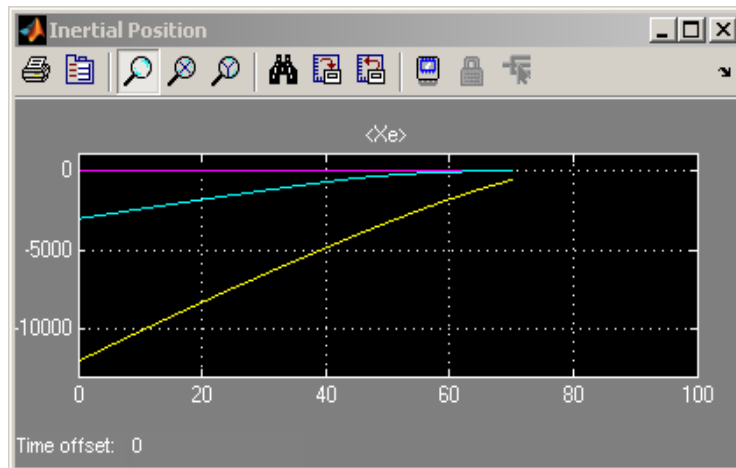
Demand and Achievement Graph



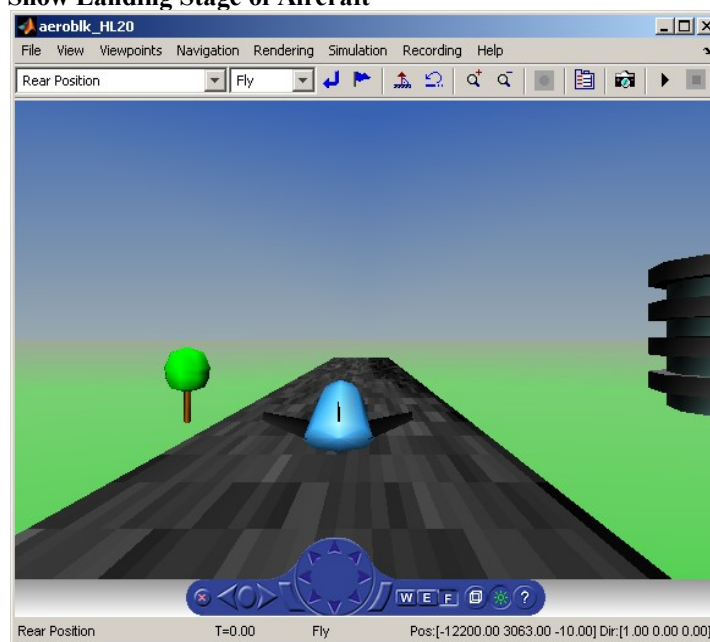
Attitudes Accelerations Mach



Inertial Position



Simulation Frame to Show Landing Stage of Aircraft



V. Conclusion

Atomic Subsystem. A subsystem treated as a unit by an implementation of the design documented in this report. The implementation computes the outputs of all the blocks in the atomic subsystem before computing the next block in the parent system's block execution order (sorted list).

Block Diagram. A Simulink block diagram represents a set of simultaneous equations that relate a system or subsystem's inputs to its outputs as a function of time. Each block in the diagram represents an equation of the form $y = f(t, x, u)$ where t is the current time, u is a block input, y is a block output, and x is a system state (see the Simulink documentation for information on the functions represented by the various types of blocks that make up the diagram). Lines connecting the blocks represent dependencies among the blocks, i.e., inputs whose current values are the outputs of other blocks. An implementation of a design described in this document computes a root or atomic system's outputs at each time step by computing the outputs of the blocks in an order determined by block input/output dependencies.

Block Parameter. A variable that determines the output of a block along with its inputs, for example, the gain parameter of a Gain block.

Block Execution Order. The order in which Simulink evaluates blocks during simulation of a model. The block execution order determined by Simulink ensures that a block executes only after all blocks on whose outputs it depends are executed.

Checksum. A number that indicates whether different versions of a model or atomic subsystem differ functionally or only cosmetically. Different checksums for different versions of the same model or subsystem indicate that the versions differ functionally.

Design Variable. A symbolic (MATLAB) variable or expression used as the value of a block parameter. Design variables allow the behavior of the model to be altered by altering the value of the design variable.

Signal. A block output, so-called because block outputs typically vary with time.

Virtual Subsystem. A subsystem that is purely graphical, i.e., is intended to reduce the visual complexity of the block diagram of which it is a subsystem. An implementation of the design treats the blocks in the subsystem as part of the first nonvirtual ancestor of the virtual subsystem .

References

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Biography



Dr. A.K. Bhardwaj

Dr. A.K. Bhardwaj is working as —Associate Professorl in the Department of Electrical and Electronics Engineering, Faculty of Engineering and Technology of Sam Higginbottom Institute of Agriculture, Technology & Sciences (Formerly AAI-DU) Allahabad, India from last 7 years after obtaining M. Tech. degree from Indian Institute of Technology Delhi, India in 2005. He has completed his Ph.D. degree from Sam Higginbottom Institute of Agriculture, Technology & Sciences (Formerly AAI-DU) Allahabad, India in July 2010. Earlier he was —Assistant Professorl in department of Electrical and Electronics Engineering, IMS Engineering College Ghaziabad (U.P.) India in the year 2005. He also worked for 6 years as faculty with IIT Ghaziabad (U.P.) India. He is also having practical experience with top class multinational companies during 1985-1998. His research interest includes, power management, energy management, reactive power control in electrical distribution system.



Er. Naser.F.AB.Elmaidub

This Work Supported by Electric Engineering Department, Sam Higginbottom Institute of Agriculture, Technology & Science Allahabad india Er. Naser.F.AB.Elmaidub —Phd student Btech from Technology College of Civil Aviation & Meterology In year 1995 Tripoli –Libya M.tech from Sam Higginbottom Institute of Agriculture, Technology & Science in year 2012