MSS Quick Reference

mssSimulink.slx	Simulink Library

Simulink demos

demoAUVdepthHeadingControl	simultaneously heading and depth control of the Remus 100 AUV
demoCS2passiveObserverDP.slx	passive observer design with wave filtering and nonlinear PID control of the CyberShip2 model ship
demoDPThrusterModels.slx	supply vessel with azimuth thrusters
demoDSRVdepthControl.slx	depth control of DSRV
demoKalmanWavefilterAutop.slx	Kalman-filter based wave filter and heading autopilot for the mariner class cargo ship
demoNavalVesselMano.slx	zigzag test for the naval ship Mano
demoNPSAUV.slx	NPS AUV heading control system
demoOtterUSVHeadingControl.slx	Otter USV heading control system
demoOtterUSVPathFollowingCourseControl	Otter USV LOS/ILOS path-following control using course autopilots
demoPanamaxContainerShip.slx	panama container ship simulator
demoPassiveWavefilterAutopilot1.slx	passive wave filter and heading autopilot design using compass measurements only
demoPassiveWavefilterAutopilot2.slx	passive wave filter and heading autopilot design using compass and yaw rate measurements
demoS175WindCurrentAutopilot.slx	S175 heading autopilot with wind and current loads
demoSemisubDPsystem.slx	semisubmersible DP system
demoWaveElevation.slx	computation of wave elevation from wave spectra
demoWaypointGuidance.slx	waypoint guidance system

Examples (m-files)

ExEKF	for-loop implementation (predictor-corrector representation) of a discrete-time extended Kalman filter (EKF)
ExFeedback	for-loop implementation for numerical integration of a 1st-order system under feedback and feedforward control
ExFFT	estimation of the wave encounter frequency from time-series using the fast-Fourier transform (FFT)
ExHybrid	computation of a hybrid continuous path parametrized by waypoints
ExINS_AHRS	Euler angle error-state (indirect) Kalman filter for INS aided by GNSS position and AHRS attitude measurements
ExINS_Euler	Euler angle error-state (indirect) Kalman filter for INS aided by GNSS position and compass measurements

ExINS_MEKF	unit quaternion error-state (indirect) Kalman filter for INS aided by position and magnetic field measurements
ExKF	for-loop implementation (predictor-corrector representation) of a discrete-time linear Kalman filter (KF)
ExKT	computation of the Nomoto gain K and time constant T from a step response using nonlinear least-squares
ExLinspec	linear approximations to the PM, JONSWAP and Torsethaugen spectra using nonlinear least-squares
ExLQFinHor	LQ finite time-horizon tracking controller for a mass-damper-spring system
ExLQR	computes the LQR gains for a mass-damper system
ExLQtrack	computes the LQ optimal tracking gains for a mass-damper system
ExMDS	plots the step response of a 2nd-order mass-damper system
ExMSI	plots the ISO 2631-1 (1997) and O'Hanlon and McCauley (1974) Motion Sickness Incidence (MSI) curves
ExNomoto	Bode plots of ships parametrized by Nomoto's 1st- and 2nd-order models
ExObsCtr	observability and controllability matrices of a supply vessel
ExOtter	simulates an Otter USV equipped with two propellers
ExPassiveObs	plots the loop transfer function of the passive observer used for heading control
ExPathGen	path generation using cubic polynomials
ExPlotRAO	script for plotting motion and force RAOs
ExPullout	performs a pullout maneuver for two different ships
ExQuadProg	quadratic programming applied to waypoint trajectory generation
ExQuest	6-DOF position/attitude vector from camera measurements using the QUEST algorithm
ExRefMod	2nd-order reference model with nonlinear damping and velocity saturation
ExResonance	computes the closed-form responses in heave, roll and pitch for a marine craft exposed to regular waves
ExRRD1	roll and sway-yaw transfer functions for the Son and Nomoto container ship
ExRRD2	rudder-roll damping (RRD) system for the Son and Nomoto container ship
ExRRD3	inverse response in roll for the Son and Nomoto container ship due to a right-half-plane zero (non-minimum phase)
ExSMC	integral sliding mode control (SMC) design for heading control
ExSpline	path generation using cubic Hermite spline interpolation
ExSTA	adaptive-gain super twisting algorithm (STA) for heading control
ExTurnCircle	generates the turning circle for two different ships
ExWageningen	computes thrust and torque curves for a propeller using the Wageningen B-series data
ExWindForce	plots the wind coefficients by Isherwoods (1972)
ExZigZag	generates zigzag maneuvers for two different ships

Vessel models (m-files)

clarke83	linear maneuvering model parametrized using (L,B,T) found from linear regression of model tests (Clarke et al. 1983)
container	nonlinear maneuvering model of a high-speed container ship, L = 175 m, including the roll mode (Son and Nomoto 1982)
DSRV	deep submergence rescue vehicle (DSRV), L = 5.0 m (Healey 1992)
frigate	nonlinear autopilot model for a frigate, L = 100 m
Lcontainer	linearized model of a high-speed container ship, L = 175 m, including the roll mode (Son and Nomoto 1982)
mariner	nonlinear maneuvering model for the Mariner class vessel, L = 160 m
navalvessel	nonlinear maneuvering model of a multipurpose naval vessel, L = 51.5 m
npsauv	Naval Postgraduate School autonomous underwater vehicle (AUV), L = 5.3 m
otter	OTTER small autonomous USV, L = 2.0 m
remus100	REMUS 100 autonomous underwater vehicle (AUV), L = 1.9 m
rig	semisubmersible linear mass-damper-spring model, L = 84.6 m
ROVzefakkel	nonlinear autopilot model of a boat, L = 45 m
supply	linear DP model of a supply vessel, L = 76.2 m
tanker	nonlinear course unstable maneuvering model of a tanker, L = 304 m

Vessel time-series simulation (m-filies)

SIMclarke83	simulate clarke83.m under PD control
SIMmariner	simulate mariner.m under PD control
SIMotter	simulate otter.m under feedback control
SIMcontainer	simulate container.m and Lcontainer.m under PD control
SIMnavalvessel	simulate navalvessel.m under PD control
SIMremus100	simulate otter.m under PD control
SIMremus100	simulate remus100.m under PD control
SIMrig	simulate the 6-DOF semisubmersible model under PID control

Modelling (m-files)

coeffLiftDrag	hydrodynamic lift and drag coefficients as a function of angle of attack of a submerged "wing profile"
forceLiftDrag	hydrodynamic lift and drag forces as a function of angle of attack of a submerged "wing profile"
crossFlowDrag	crossflow drag computed from strip theory integrals

Dmtrx	6x6 linear damping matrix for marine craft (submerged and floating)
Gmtrx	6x6 system spring stiffness matrix G
gvect	6x1 vector of restoring forces
imlay61	6x6 hydrodynamic added mass and Coriolis-centripetal matrices MA and CA for a prolate spheroid
m2c	6x6 Coriolis-centripetal matrix C(nu) from system inertia matrix M
rbody	6x6 rigid-body system inertia and Coriolis-centripetal matrices MRB and CRB of a general body
spheroid	6x6 rigid-body system inertia and Coriolis-centripetal matrices MRB and CRB of a prolate spheroid
wageningen	thrust and torque coefficients of the Wageningen B-series propellers

Kinematics (m-files)

ecef2llh	longitude, latitude and height from ECEEF positions x, y and z
euler2q	unit quaternion from Euler angles
eulerang	computes the Euler angle transformation matrices J, Rzyx and Tzyx
flat2llh	longitude, latitude and height from flat-earth positions x, y and z
llh2ecef	ECEEF positions x, y and z from longitude, latitude and height
llh2flat	flat-earth positions x, y and z from longitude, latitude and height
R2euler	Euler angles from rotation matrix elements
Rll	Euler angle rotation matrix Rll for longitude and latitude
Rquat	unit quaternion rotation matrix R in SO(3)
Rzyx	Euler angle rotation matrix R in SO(3)
Tquat	unit quaternion transformation matrix T, representing the attitude dynamics
Tzyx	Euler angle transformation matrix T, representing the attitude dynamics
q2euler	Euler angles from a unit quaternion
quatern	unit quaternion transformation matrix J
quatprod	quaternion product
quest	quaternion rotation matrix R(q) and unit quaternion q between two vectors W = R(q) V
quest6dof	6-DOF vector eta = [x,y,z,phi,theta,psi] from three marker positions using the QUEST algorithm

Transformations (m-files)

conversion	defines global conversion factors for GNC applications
rad2pipi	obsolete, use ssa
ssa	smallest signed angle, maps an angle in rad to the interval [-pi pi) or [-180 180)
Smtrx	3x3 vector skew-symmetric matrix S
Hmtrx	6x6 system transformation matrix H
vex	computes a = vex(S(a)) where S is a skew-symmetric matrix

Environment (m-files)

blendermann94	computes the wind forces and wind coefficients using Blendermann (1994)
encounter	encounter frequency as a function of wave peak frequency, vessel speed and wave direction
hs2vw	converts significant wave height into an equivalent wind speed
isherwood72	computes the wind forces and coefficients based on Isherwood (1972)
rand_phases	generates a uniformly distributed vector of random phases in the interval [-pi pi]
vw2hs	converts average wind speed to significant wave height
waveresponse345	steady-state heave, roll and pitch responses for a ship in regular waves
wavespec	function used to evaluate different type of wave spectra
ww2we	function used to transform a vector of wave frequencies to encounter frequencies

Ship maneuvers (m-files)

pullout	ship pullout maneuver
turncircle	ship turning circle
zigzag	ship zigzag maneuver

Motion sickness (m-files)

ISOmsi	ISO 2631-3, 1997 motion sickness incidence
HMmsi	O'Hanlon and McCauley (1974) motion sickness incidence

Hydrodynamics (m-files)

DPperiods	periods and natural frequencies of a marine craft in DP
Hoerner	2D Hoerner crossflow form coefficient as a function of B and T
loadcond	plots the roll and pitch periods as a function of GM_T and GM_L
plotABC	plots the hydrodynamic coefficients Aij, Bij and Cij as a function of frequency
plotBv	plots viscous damping Bvii as a function of frequency
plotTF	plots the motion or force RAO transfer functions
plotWD	plots the wave drift amplitudes

Hydrodynamic templates (Simulink)

DP_ForceRAO.slx	Simulink template for a DP vessel where wave loads are computed using force RAOs
DP_MotionRAO.slx	Simulink template for a DP vessel where wave loads are computed using motion RAOs
MAN_ForceRAO.slx	Simulink template for the unified maneuvering model where wave loads are computed using force RAOs

Processing of data from hydrodynamic codes (m-files)

veres2vessel	reads data from ShipX output files and store the data as a mat-file containing the structure <vessel>
vessel2ss	computes the fluid-memory transfer functions and store the data as a mat-file containing the structure <vesselABC>
wamit2vessel	reads data from WAMIT output files and store the data as a mat-file containing the structure <vessel>

Data files (mat-files that can be loaded to workspace and used by Simulink templates)

fpso, fpsoABC	WAMIT data for a FPSO	s175, s175ABC	ShipX data for a supply vessel
semisub, semisubABC	WAMIT data for a semisubmersible	supply, supplyABC	ShipX data for the S175
tanker, tankerABC	WAMIT data for a tanker		

vessel and vesselABC structures

vessel struct with fields:	vessel.main struct with fields:	vesselABC struct with fields:
main: [1×1 struct] velocities: 0 headings: [1×36 double] MRB: [6×6 double] C: [6×6×60 double] freqs: [1×60 double] A: [6×6×60 double] B: [6×6×60 double] motionRAO: [1×1 struct] forceRAO: [1×1 struct] driftfrc: [1×1 struct] Bv: [6×6×60 double]	name: 'tanker' T: 10 B: 46 Lpp: 246 m: 94620210 rho: 1025 k44: 17.0200 k55: 63.9600 k66: 66.4200 g: 9.8066 nabla: 9.2312e+04 CB: [3.9259 0 5.1845] GM_T: 9.9823 GM_L: 470.9226 CG: [3.9300 0 12.5000]	Ar: {6×6 cell} Br: {6×6 cell} Cr: {6×6 cell} Dr: {6×6 cell} MRB: [6×6 double] MA: [6×6 double] G: [6×6 double] Minv: [6×6 double] r_g: [3.9300 0 -2.5000]

Guidance (m-files)

crosstrack	computes the path-tangential origin and cross-track error for a target
crosstrackWpt	computes the cross-track error when the path is a straight line between two waypoints
hybridPath	generates coefficients for subpaths between waypoints
LOSchi	LOS guidance law for course autopilot control (see demoOtterUSVPathFollowingCourseControl.slx)
ILOSchi	ILOS guidance law for course autopilot control (see demoOtterUSVPathFollowingCourseControl.slx)
order3	path generation using cubic polynomials (see demoWaypointGuidance.slx)
order5	path generation using 5th-order polynomials (see demoWaypointGuidance.slx)

Navigation (m-files)

acc2rollpitch	static roll and pitch angles from specific force
gravity	acceleration of gravity as a function of latitude using the WGS-84 ellipsoid parameters
ins_ahrs	error-state Kalman filter for INS aided by position and AHRS measurements
ins_euler	error-state Kalman filter for INS aided by position and yaw angle measurements
ins_mekf	error-state Kalman filter for INS aided by position and magnetic field measurements
ins_mekf_psi	error-state Kalman filter for INS aided by position and yaw angle measurements
insSignal	basic INS signal generator

Control (m-files)

lqtracker	computes the LQ tracker gain matrices for LTI systems
nomoto	generates Bode plots for the 1st- and 2nd-order Nomoto models
ucalloc	unconstrained control allocation

Numerical integration methods (m-files)

euler2	integrates a system of ordinary differential equations using Euler's 2nd-order method
rk4	integrates a system of ordinary differential equations using Runge-Kutta's 4th-order method