HOMEOSTATIC-INSPIRED CONTROLLER ALGORITHM FOR A HYBRID-DRIVEN AUTONOMOUS UNDERWATER GLIDER

By

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LIST OF ABBREVIATIONS

2D	-	Two-Dimensional
3D	-	Three-Dimensional
Ab	-	Antibody
ADCP	-	Acoustic Doppler Current Profiler
AES	-	Artificial Endocrine System
Ag	-	Antigen
AHRS	-	Attitude and Heading Reference System
AI	-	Artificial Intelligence
AIS	-	Artificial Immune System
ANN	-	Artificial Neural Network
AoA	-	Angle of attack
AOSN	-	Autonomous Oceanographic Sampling System
AUG	-	Autonomous Underwater Glider
AUV	-	Autonomous Underwater Vehicle
BEC	-	Battery Eliminator Circuit
BPAUV	-	Battlespace Preparation Autonomous Underwater Vehicle
CA	-	Centre of Mass
CAD	-	Computer-Aided Design
CB	-	Centre of Buoyancy
CFD	-	Computational Fluid Dynamics
CG	-	Centre of Gravity
CSA	-	Clonal Selection Algorithm
CTD	-	Conductivity, Temperature, and Depth

DC	-	Direct current
DOF	-	Degree-of-Freedom
DVL	-	Doppler Velocity Logger
ESC	-	Electronic Speed Control
FLC	-	Fuzzy Logic Control
GA	-	Genetic Algorithm
GPS	-	Global Positioning System
HDPE	-	High Density Polyethylene
HF	-	High Frequency
IDE	-	Integrated Development Environment
IMU	-	Inertial Measurement Unit
Li-Po	-	Lithium polymer
LQG	-	Linear-Quadratic-Gaussian
LQR	-	Linear-Quadratic Regulator
MIMO	-	Multiple-Input-Multiple-Output
MLP	-	Multilayer Perceptron
MMS	-	Marine Systems Simulator
MPC	-	Model Predictive Control
NACA	-	National Advisory Committee for Aeronautics
NMEA	-	National Marine Electronics Association
OMLPNN	-	Online Multilayer Perceptron Neural Network
PC	-	Personal Computer
PD	-	Proportional-Derivative
PID	-	Proportional-Integral-Derivative
PLUSNet	-	Persistent Littoral Undersea Surveillance Network

PWM	-	Pulse Width Modulation
RC	-	Radio Control
REMUS	-	Remote Environmental Monitoring Units
RF	-	Radio Frequency
ROV	-	Remotely Operated Vehicle
SCL	-	Serial clock
SD	-	Secure Digital
SDA	-	Serial data signal
SIFLC	-	Single Input Fuzzy Logic Control
SIO	-	Scripps Institution of Oceanography
SISO	-	Single-Input-Single-Output
SMC	-	Sliding Mode Control
SODMN	-	Self-Organization Direction Mapping Network
SONCS	-	Self-Organizing Neural-net Control System
SPAWAR	-	Space and Naval Warfare
SPI	-	Serial Peripheral Interface
SPURV	-	Self-Propelled Underwater Research Vehicle
UARS	-	Unmanned Arctic Research Submersible
UART	-	Universal asynchronous receiver/transmitter
USBL	-	Ultra-short Baseline
UUV	-	Unmanned Underwater Vehicle
VHF	-	Very High Frequency
WHOI	-	Woods Hole Oceanography Institute
WRC	-	Webb Research Corporation

LIST OF SYMBOLS

$C_A(V)$	-	Added Coriolis-centripetal matrix
τ_A	-	Added mass forces and moments
M_A	-	Added mass inertia matrix
AC_t	-	Aerodynamic/hydrodynamic centre of tail area
AC_{wb}	-	Aerodynamic/hydrodynamic centre of wing-body area
α	-	Angle of attack
ω_2	-	Angular velocities
A_{ht}	-	Axial force of tail area
A_{wb}	-	Axial force of wing-body area
m_b	-	Ballast point mass
$x_b y_b z_b$	-	Body reference frame axes
B	-	Buoyancy
$C(V)$	-	Coriolis-centripetal forces and moments
$D(V)$	-	Damping forces and moments
τ_{Db}	-	Damping forces on glider body
τ_{Dlw}	-	Damping forces on left wing
τ_{Drw}	-	Damping forces on right wing
τ_{Dr}	-	Damping forces on rudder
δ_{lw}	-	Deflection angle of left wing
δ_{rw}	-	Deflection angle of right wing
δ_r	-	Deflection angle of rudder
d	-	Diameter

C_D	-	Drag coefficient
m_w	-	Fixed point mass
τ	-	Forces and moments vector action on glider body
τ_{FK}	-	Froude-Kriloff forces
U	-	Glider speed
m_{rb}	-	Glider total mass
V	-	Glider velocity
g	-	Gravitational acceleration
w	-	Heave
m_h	-	Hull mass
x_{hc}	-	Hydrodynamic centre
I_c	-	Inertia matrix about the centre of gravity
I_o	-	Inertia matrix about the origin
$x_i y_i z_i$	-	Inertial frame axes
m_p	-	Internal moving mass
T	-	Kinetic enegry
L	-	Length of glider body
C_L	-	Lift coefficient
D	-	Linear damping
m	-	Mass of fluid displaced
P_m	-	Middle point position
C_M	-	Moment coefficient
x_m	-	Moment reference location
m_0	-	Net buoyancy

$D_n(V)$	-	Nonlinear damping matrix
N_{ht}	-	Normal force of tail area
N_{wb}	-	Normal force of wing-body area
θ	-	Pitch angle
q	-	Pitch rate
A_p	-	Planform area
τ_P	-	Propeller forces
r	-	Radius
A_r	-	Reference area
V_r	-	Relative velocities and accelerations to water currents
$g(n)$	-	Restoring forces and moments
$C_{RB}(V)$	-	Rigid-body Coriolis-centripetal matrix
M_{RB}	-	Rigid-body inertia matrix
$\emptyset$	-	Roll angle
p	-	Roll rate
m_{py}	-	Rotating moving mass
$J(\eta)$	-	Rotation and transformation matrix of Euler angles
δ	-	Rotation angle of the wings and rudder
R	-	Rotation matrix
R_{lw}	-	Rotation matrix of left wing
R_{rw}	-	Rotation matrix of right wing
R_r	-	Rotation matrix of rudder
$\widehat{\omega}_2$	-	Skew-symmetric matrix of angular velocities
β	-	Sideslip angle

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