Nomenclature

Acronyms

AC America's Cup; sailing competition and the oldest international competition still operating in any sport.. 1, 2, 23, VII

AoA Angle between a body's reference line and the incoming flow velocity vector. 16, 18, 37

CFD Computational Fluid Dynamics. 18, 20, 33, 38, 41, VII

D3 D3 Applied Technologies, S.L. (website). 2, 3, 20, 25, 36, 39, 52, VII, XI

DOF Degrees of Freedom. 5, 9

DVPP Dynamic Velocity Prediction Program. 18, 22, VII

FSI fluid–structure interaction. 32, 33

LE Leading Edge; Forward edge of a foil or wing. Line that goes tip to tip. 32, 37

LHS See latin hypercube sampling (LHS). XVI

LL lifting-line theory. 32, 33

PID proportional–integral–derivative controller. 3, 4, 16, 25, 34, 48, 49, 51, 65, 75, 77, 81, 83, VII

RANS Reynolds-Averaged Navier-Stokes; CFD method that time-averages the flow and solves the mean field with a turbulence model (e.g. $k-\epsilon$, $k-\omega$). 5

SiM Simulator In Motion (website). 1–3, 25–27, 33, 35, 36, 39, 52, VII, XI

TWA True Wind Angle; the angle between the boat's heading and the direction of the true wind. ºDEG. 20, 35, XVI, XIX

TWD True Wind Direction; the direction from which the true wind is blowing, relative to north. ºDEG. 30, XVI

TWS True Wind Speed; the speed of the wind relative to the stationary ground, units of knots or m/s. 30, 42, VII

VMG Velocity Made Good; the component of a boat's velocity in the direction of the true wind, used as a measure of sailing efficiency. Kn. 11, 17, 18, 42, 57–66, 68, 71, XIX

VMG Speed of the sailing boat projected in the direction of the true wind (TWD). 20, VII

VPP Velocity Prediction Program. 2–5, 17, 21, 22, 66, VII

Glossary

aspect ratio Relationship between the span of a foil and its chord. A high-aspect ratio wing has very long span and narrow chord and vice-versa. 10

bias adjuster Flight system control, that allows to effectively change the length of the push rod from the wand to the foil via an endless screw. It adjusts the ride height offset.. 16, 68, XVIII

blade See vertical. 32, XIX

boom Horizontal spar, attached at its forward end to the mast, used to extend and control the foot of the mainsail. XVIII

chord Straight-line distance between the leading edge and trailing edge of a foil, measured in the direction of the fluid flow. XVI

design of experiments (DoE) Statistical framework for planning runs to efficiently explore how inputs affect outputs. Common designs include full-factorial design, response-surface designs, orthogonal arrays and Latin hypercube sampling (LHS). 20

downwind Point of sail when the boat is sailing with the wind coming from behind, in moth sailing, the downwind condition encompasses broad reaching and running. 115° - 175° TWA. 10

elevator See horizontal. 32, XVII

flat Flattening coefficient of the sail profiles, directly related to the power generated by them, defined in the VPP. 20

foiling That uses a hydrofoil. 9, XVII

forestay Part of the standing rigging consisting of a wire or rope running from the upper front section of the mast to the bow of the boat, providing forward support for the mast. XVIII

fluid–structure interaction Coupled problem in which fluid loads deform or move a structure and the resulting motion alters the flow. XV

full-factorial design Design of experiments where all combinations of factor levels are tested. 20, XVI

gantry Aft structure projecting from the Moth transom that connects and transmits the forces of the rudder, situated aft of the hull, it increases pitch lever arm.. 32, 37

gearing key parameter that controls the ratio between wand angle and flap angle in the moth flight system. The sailor can touch the gearing while sailing, from position 1 to 6, to control how the boat behaves in waves. See § 2.3.5 and Fig. 5.2 for system description and § 5.3 for influence. 3, 14, 16, 34, 51, 55, VII

gradient descent Iterative optimisation method that updates parameters in the direction of negative gradient of the objective. 20

horizontal Horizontal lifting surface; on the mainfoil called the wing, on the rudder the elevator; generates lift or downforce for heave/pitch control. 20, 32, 33, 37, XVI, XIX

hydrofoil A lifting surface, i.e. "foil", e.g. a horizontal wing, that operates in water to raise the vessel's hull above the free surface. VII, XVI

International Moth 3.35-metre-long sailing foiling monohull, built in carbon fibre under the International Moth class rule, recognised by World Sailing. See 2.3. 1, 25, VII, XVIII

Kd Derivative gain. Scales the error's time derivative to add damping and anticipate changes; sensitive to measurement noise. 35, 51, 75, 79, 80, VII

Ki Integral gain. Scales the time–integral of the error to remove steady–state offset; too large may cause windup and oscillations. 35, 51, 75, 78, 80, VII

Kp Proportional gain. Scales the instantaneous error $e(t)$ to increase responsiveness; excessive values can amplify noise or overshoot. 35, 51, 75, 77, 80, VII

latin hypercube sampling (LHS) Sampling scheme that divides each input dimension into equal-probability bins and samples each bin exactly once per dimension. 20, XV

lifting-line theory Mathematical model that predicts lift distribution over a three-dimensional finite wing/foil in inviscid, incompressible flow to compute circulation, lift distribution and induced drag (best for thin, moderately loaded, high-aspect-ratio foils). 32, 33, 36, 48, XV

line search basic iterative approach to find a local minimum of an objective function along a given descent direction (e.g., gradient). 52

mainfoil Front T-hydrofoil assembly in the Moth (aka *main*); provides most of the vertical lift.. 56

mainsail The principal and typically largest sail on a sailing vessel, set aft of the main mast and attached along its luff to the mast and along its foot to the boom. In the case of the moth it is the only sail used (in opposition to other types of vessels with, e.g., mainsail and headsail). XVI

monohull A type of vessel characterized by a single main hull, as opposed to multihull designs such as catamarans or trimarans. XVII

moth See International Moth. 3, 9, 10, XVIII

perturbations method Sensitivity method that varies a single input slightly around a baseline to estimate its effect. 20

rake angle of rotation on the local Y-axis (horizontal and transversal to the sailboat) of the different movable elements on-board. 12

ride height offset neutral flap angle bias. Sailors adjust this control to achieve the desired ride height, after selecting the desired wand length and gearing. See bias adjuster. 16, XVI

rig The set of mast plus sail(s) plus associated elements, e.g., in the moth: shrouds, forestay and boom. 10

rudder Aft steering appendage; on the moth it carries a horizontal *elevator* that adds pitch stability and trim authority. 10, 12

sailplan Arrangement of the sails and spars of a sailing vessel, defining its rig type and sail area distribution. 11

shroud Part of the standing rigging consisting of wires or ropes running from the mast to the sides of the vessel to provide lateral support and keep the mast upright. XVIII

span Tip-to-tip distance across a foil, measured perpendicular to the direction of the flow. XVI

strut See vertical. 32, XIX

upwind Point of sail when the boat is heading as close to the wind direction as possible (close-hauled), for the International Moth, the best-VMG lies between 35º – 50º TWA, almost a close reaching. 10

vertical Vertical member of a hydrofoil (also strut in case of the mainfoil; or blade on the rudder); connects hull to the horizontal surface and transmits loads. 20, 32, 37, XVI, XIX

vortex lattice method Potential-flow panel method that discretises the lifting surface into an infinitely thin sheet of discrete vortices; the influence of the thickness and viscosity is neglected. 36

wand Carbon fibre rod that touches the water and through a linkage system (gearing and offset), it transmits a control input to the foil flap.. 3, 5, 14, 34, 49, 51, 66, VII

wing See horizontal. 32, XVII

World Sailing The governing body of sailing worldwide, formally known as the International Sailing Federation (ISAF). XVII