List of Symbols and Abbreviations

Roman Symbols

$\mathbf{a}_l$	The tensors of the Taylor expansion of the Rosenhead-Moore kernel, defined by Eq. 2.44
$\mathbf{c}_i$	The centre of the computational cell i
$\mathbf{m}_\mathbf{l}$	The moments of the vorticity field defined by Eq. 2.45
$\mathbf{u}_b$	The velocity of the flow at the blades of the rotor
$\mathbf{v}$	The velocity of the flow
$\mathbf{v}_b$	The flow velocity at the friction height of 10 cm, called the near-bed velocity
$\mathbf{v}_r$	The rotational part of the flow velocity
$\mathbf{v}_{fs}$	The free-stream velocity / the inflow velocity
$\mathbf{v}_{i+1/2}$	The velocity at the cell face between cells i and $i+1$
$\mathbf{w}_s$	The settling velocity, the threshold for sediment deposition
c_b	The concentration of the bed load
C_D	The drag coefficient, used in Eq. 3.1
c_d	The particle drag coefficient

c_s	The concentration of the suspended load, also denoted as c
c_{ref}	The concentration of suspended load at a reference level
d	The sediment size
d^*	The dimensionless sediment size, given by Eq. 3.4
E	The erosion flux / the erosion rate
E_0	The empirical constant in the definition of the erosion flux Eq. 3.8
$F_{i-1/2}$	The vorticity flux from cell $i-1$ to i
g	The gravitational acceleration
k_s	The bed roughness constant
K_δ	The Rosenhead-Moore kernel
$L(\mathbf{v})$	The vorticity transport operator, defined by Eq. 2.61
l_{VATT}	The length of the blades of the VATT
N_b	The number of the blades of the TECD
N_Ω	The number of computational cells in the domain Ω
p	The pressure
q_b	The bed load
q_j	The generalised coordinates of the rotor system, $j = 1...s$
R	The radius of the rotor blades
$r_{i+1/2}$	The vorticity distribution ratio between cells i and $i+1$
R_{VATT}	The radius of the VATT

S_1	The part of the computational domain Ω which contains the well-separated clusters
S_2	$\Omega \setminus S_1$
S_c	The source of suspended load
S_ω	The source of vorticity
$S_{int}(\mathbf{v})$	The source of the tide induced wake vorticity, ω^*
S_R	The source of the rotor vorticity, ω_w
$supp(\omega)$	The support of the vorticity field
t_0	The time when the wake reaches the fully developed state
t_{END}	The time of the simulations' end
T_{rr}	The time of one rotor revolution
$TV(\omega)$	The total variation of the vorticity field
V_i	The volume of computational cells, $i = 1...N_\Omega$
v_t	The threshold velocity, given by Eq. 3.5
v_{hub}	The inflow velocity at the rotor hub
V_{in}	The magnitude of the inflow velocity equal to its x-component
$v_{R/2}$	The inflow velocity in the middle of the VATT
v_{tip}	The velocity of the blade tip
W_s	The magnitude of the settling velocity
W_{in}	The magnitude of the free-stream vorticity field, $W_{in}(z) = dV_{in}/dz$
z_b	The friction height 10 cm

z_{hub}	The vertical coordinate of the rotor hub
$z_{R/2}$	The vertical position of the middle of the VATT
$\mathcal{D}_t$	The rate of energy dissipation
$\mathcal{Q}$	The generalised external forces on the rotor system
$\mathcal{T}$	The kinetic energy of the blades
$\mathcal{V}$	The potential energy
$\mathcal{W}$	The work done by the external forces $\mathcal{Q}$
$[\cdot]^n$	The operator of integration over the computational cell at time $n\Delta t$

Greek Symbols

δ	The variation of the trajectory through the space defined by $(q, \dot{q})$
δ_b	The thickness of the bed load layer
Δt	The time step
Δv_{2R}	The difference of the inflow velocity across the HATT
Δv_R	The difference of the inflow velocity across the VATT
$\Delta v_{0.66R}$	The difference of the inflow velocity across the CFTT
ϵ	The sediment diffusivity
$\epsilon_{\mathbf{p}}$	The estimate of the truncation error of the Taylor expansion, defined by Eq. 2.46
ϕ	The velocity potential
Γ	The vortex strength
η	The vertical component of the sediment diffusivity
θ	The dimensionless bed shear stress, given by Eq. 3.2
θ_{cr}	The critical bed shear stress, given by Eq. 3.3
θ_0	The empirical constant listed in table 3.1
λ	The wave amplifier function
μ	The Courant-Friedrich-Lewy (CFL) number
μ_0	The coefficient of static friction
ν	The kinematic viscosity of the seawater
ω	The vorticity of the fluid

ω_b	The vorticity bound to the blades of the rotor
ω_{fs}	The free-stream vorticity
ω_I	The vorticity induced by the presence of a TECD, $\omega_I = \omega_w + \omega^*$
ω^*	The tide induced wake vorticity
ω_w	The rotor vorticity
$[\omega]_i$	The integral of the vorticity over the computational cell i
Ω	The computational domain
π	The ratio of circumference to diameter of a circle
ρ	The density of the seawater
ρ_s	The density of sediment
σ	The empirical power coefficient listed in table 3.1
τ	The well-separated clusters
τ_b	The shear stress exerted by the fluid on the seabed
ξ	The excess bed shear stress (EXSS)
ξ_2^v	The quadratic coefficient in Eq. 5.10
ξ_1^v	The linear coefficient in Eq. 5.10
ξ_0^v	The constant in Eq. 5.10
ξ_{-2}^z	The coefficient in Eq. 5.14

Abbreviations

AEXSS	Average EXSS
AR	Aspect Ratio
CFATT	Cross-Flow Tidal Turbine in anti-clockwise operation
CFCTT	Cross-Flow Tidal Turbine in clockwise operation
CFD	Computational Fluid Dynamics
CFL	Courant-Friedrich-Lewy number
CFTT	Cross-Flow Tidal Turbine
DNS	Direct Numerical Simulation
EMEC	European Marine Energy Centre
EXSS	EXcess bed Shear Stress
FMM	Fast Multipole Method
HATT	Horizontal Axis Tidal Turbine
MAEXSS	Mean AEXSS over $[t_0, t_{END}]$
NACA	National Advisory Committee for Aeronautics
REEF	Relative Excess Erosion Flux
TECD	Tidal Energy Conversion Device
TE	TECD-Environment system
TSR	Tip Speed Ratio
VATT	Vertical Axis Tidal Turbine
VTM	Vorticity Transport Model
WAF	Weighted Average Flux
WWF	World Wide Fund for Nature