Nomenclature

Controller Design for Wind Turbines and Wind Farms

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The main idea of this document is to provide an overview of all Abbreviations and symbols used in the lecture. Please let us know if something is missing.

List of Symbols

Greek letters

α_h	horizontal inflow angle
α_v	vertical inflow angle
δ_h	linear horizontal wind shear
δ_v	linear vertical wind shear
η_el	efficiency of the electro-mechanical energy conversion
λ	tip speed ratio
Ω	rotor speed
Ω_G	generator speed
ρ	air density
θ	collective blade pitch angle
θ_fine	minimum blade pitch angle for ensuring region 3 torque

Roman letters

a	torque controller parameter for transistion regions
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c_P	power coefficient
c_T	thrust coefficient
r_GB	gearbox ratio, $i_\mathrm{GB} = 1/r_\mathrm{GB}$ from [1]
J	sum of the moments of inertia about the rotation axis
k	stiffness; wavenumber; torque controller parameter region 2
M_a	aerodynamic torque
M_G	generator torque
P_el	electrical power
R	rotor radius
u	longitudinal wind speed
v	lateral wind speed
v_0	rotor effective wind speed
w	vertical wind speed
x	longitudinal coordinate; longitudinal displacement
y	lateral coordinate; lateral displacement
z	vertical coordinate; vertical displacement

Subscripts

$(\cdot)_1, (\cdot)_{1.5}, (\cdot)_2, (\cdot)_{2.5}, (\cdot)_3$	referring to control regions
$(\cdot)_\mathcal{I}$	referring to inertial frame coordinate system

$(\cdot)_{\mathcal{L}}$	referring to lidar coordinate system
$(\cdot)_{\mathcal{W}}$	referring to wind coordinate system
$(\cdot)_{\max}$	referring to a maximum value
$(\cdot)_{\min}$	referring to a minimum value
$(\cdot)_{\text{opt}}$	referring to a optimal value in region 2
$(\cdot)_{\text{rated}}$	referring to a rated value in region 3

Abbreviations

3P	three-per-revolution
CFD	Computational Fluid Dynamics
DEL	Damage Equivalent Load
DLC	Design Load Case
DLL	Dynamic Link Library
DOF	Degree Of Freedom
EOG	Extreme Operating Gust
FAST	Fatigue, Aerodynamics, Structures, and Turbulence
IEC	International Electrotechnical Commission
IPC	Individual Pitch Control
NREL	National Renewable Energy Laboratory
ODE	Ordinary Differential Equation
PDE	Partial Differential Equation
PI	Proportional-Integral
PLC	Programmable logic controller
PSD	Power Spectral Density
SLOW	Simplified Low Order Wind turbine
STD	STandard Deviation
SWE	Stuttgart Wind Energy

References

[1] D. Schlipf. "Lidar-Assisted Control Concepts for Wind Turbines". PhD thesis. University of Stuttgart, 2015. DOI: 10.18419/opus-8796.