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*To my wife Zsuzsanna,
my son Peter
and also to the memory of
my father and identical twin brother*

Glossary of symbols

\bar{a}	complex spatial operator ($e^{j2\pi/3}$)	
\mathbf{C}_2	commutator transformation matrix	
f	magnetomotive force (m.m.f.)	At
i_a	instantaneous value of the armature current	A
i_D	instantaneous value of the d.c. link current	A
$\bar{i}_{ms} (\bar{i}_{ms})$	space phasor of the stator magnetizing currents expressed in the magnetizing-flux-oriented reference frame	A
$\bar{i}_{mr} (\bar{i}_{mr})$	space phasor of the rotor magnetizing currents expressed in the magnetizing-flux-oriented reference frame	A
$\bar{i}_r (\bar{i}_r)$	space phasor of the rotor currents expressed in the rotor reference frame	A
$\bar{i}'_r (\bar{i}'_r)$	space phasor of the rotor currents expressed in the stator reference frame	A
$\bar{i}_{rg} (\bar{i}_{rg})$	space phasor of the rotor currents expressed in the general reference frame	A
$\bar{i}_{rm} (\bar{i}_{rm})$	space phasor of the rotor currents expressed in the magnetizing-flux-oriented reference frame	A
$\bar{i}_{r\psi_s} (\bar{i}_{r\psi_s})$	space phasor of the rotor currents expressed in the stator-flux-oriented reference frame	A
i_{ra}, i_{rb}, i_{rc}	instantaneous values of the rotor currents in rotor phases ra, rb, rc respectively	A
i_{rd}, i_{rq}	instantaneous values of direct- and quadrature-axis rotor currents expressed in the stator reference frame	A
i_{rx}, i_{ry}	instantaneous values of direct- and quadrature-axis rotor current components respectively and expressed in the rotor reference frame	A
i_{rx}, i_{ry}	instantaneous values of the direct- and quadrature-axis rotor current components respectively and expressed in the general or special reference frames	A
$\bar{i}_s (\bar{i}_s)$	space phasor of the stator current expressed in the stator reference frame	A
$\bar{i}'_s (\bar{i}'_s)$	space phasor of the stator currents expressed in the rotor reference frame	A
$\bar{i}_{sg} (\bar{i}_{sg})$	space phasor of the stator currents expressed in the general reference frame	A
$\bar{i}_{sm} (\bar{i}_{sm})$	space phasor of the stator currents expressed in the magnetizing-flux-oriented reference frame	A

$\bar{i}_{s\psi r}$ ($\bar{i}_{s\psi r}$)	space phasor of the stator currents expressed in the rotor-flux-oriented reference frame	A
$\bar{i}_{s\psi s}$ ($\bar{i}_{s\psi s}$)	space phasor of the stator currents expressed in the stator-flux-oriented reference frame	A
i_{sA}, i_{sB}, i_{sC}	instantaneous values of the stator currents in stator phases sA, sB, sC respectively	A
i_{sD}, i_{sQ}	instantaneous values of direct- and quadrature-axis stator current components respectively and expressed in the stationary reference frame	A
i_{sd}, i_{sq}	instantaneous values of the direct- and quadrature-axis stator current components respectively and expressed in the rotor reference frame	A
i_{sx}, i_{sy}	instantaneous values of the direct- and quadrature-axis stator current components respectively and expressed in the general or special reference frames (flux and torque producing stator current components respectively)	A
i_{s0}	instantaneous value of zero-sequence stator current component	A
J	polar moment of inertia	kgm ²
L	dynamic inductance	H
L_{DQ}	cross-magnetizing coupling inductance	H
L_F	inductance of filter	H
L_m	magnetizing inductance	H
L_s, L_{sl}	self- and leakage inductances of the stator respectively	H
L_r, L_{rl}	self- and leakage inductances of the rotor respectively	H
L'_s, L'_r	stator and rotor transient inductances respectively	H
$p = d/dt$	differential operator	
p_s, p_r	instantaneous powers of the stator and rotor respectively	W
P	number of pole-pairs	
R_F	resistance of filter	Ohm
R_s, R_r	resistances of a stator and rotor phase winding respectively	Ohm
t	time	s
t_e	instantaneous value of the electromagnetic torque	Nm
t_l	load torque	Nm
T	time lag	s
T_s, T_r	stator and rotor time constants respectively	s
T'_s, T'_r	stator and rotor transient time constants respectively	s
u_D	instantaneous output voltage of rectifier	V
u_{dx}, u_{dy}	instantaneous values of the direct- and quadrature-axis decoupling voltage components expressed in the special reference frames	V

\vec{u}_s	space phasor of the stator voltages expressed in the stator reference frame	V
\vec{u}_{sg}	space phasor of the stator voltages expressed in the general reference frame	V
\vec{u}_{sm}	space phasor of the stator voltages expressed in the magnetizing-flux-oriented reference frame	V
$\vec{u}_{s\psi_s}$	space phasor of the stator voltages expressed in the stator-flux-oriented reference frame	V
$\vec{u}_{s\psi_r}$	space phasor of the stator voltages expressed in the rotor-flux-oriented reference frame	V
u_{sA}, u_{sB}, u_{sC}	instantaneous values of the stator voltages in phases sA, sB, sC respectively	V
u_{sD}, u_{sQ}	instantaneous values of direct- and quadrature-axis stator voltage components respectively and expressed in the stationary reference frame	V
u_{sx}, u_{sy}	instantaneous values of the direct- and quadrature-axis stator voltage components respectively and expressed in the general or special reference frames	V
\vec{u}_r	space phasor of the rotor voltages expressed in the rotor reference frame	V
\vec{u}'_r	space phasor of the rotor voltages expressed in the stator reference frame	V
\vec{u}_{rg}	space phasor of the rotor voltages expressed in the general reference frame	V
$\vec{u}_{r\psi_s}$	space phasor of the rotor voltages expressed in the stator-flux-oriented reference frame	V
u_{rd}, u_{rq}	instantaneous values of the direct- and quadrature-axis rotor voltages respectively and expressed in the stator reference frame	V
u_{rx}, u_{ry}	instantaneous values of the direct- and quadrature-axis rotor voltages respectively and expressed in the general or special reference frames	V
$u_{rx}, u_{r\beta}$	instantaneous values of the direct- and quadrature-axis rotor voltages respectively and expressed in the rotor reference frame	V
u_{r0}	instantaneous value of the zero-sequence rotor voltage	V
W_{mech}	instantaneous value of mechanical output energy	J
$z = e^{sT}$	discrete Laplace variable	
δ	load angle	rad
θ_r	rotor angle	rad
μ_m	phase angle of the magnetizing flux linkage space phasor with respect to the direct-axis of the stator reference frame	rad

ρ_r	phase angle of the rotor flux linkage space phasor with respect to the direct-axis of the stator reference frame	rad
ρ_s	phase angle of stator flux linkage space phasor with respect to the direct-axis of the stator reference frame	rad
σ	resultant leakage constant	
σ_r	rotor leakage constant	
ψ_f	excitation flux linkage	Wb
$\bar{\psi}'_m$	space phasor of magnetizing flux linkages expressed in the stator reference frame	Wb
$\bar{\psi}_{m\psi r}$	space phasor of magnetizing flux linkages expressed in the rotor-flux-oriented reference frame	Wb
$\bar{\psi}_{m\psi s}$	space phasor of magnetizing flux linkages expressed in the stator-flux-oriented reference frame	Wb
ψ_{md}, ψ_{mq}	instantaneous values of the direct- and quadrature-axis magnetizing flux linkage components expressed in the rotor reference frame	Wb
$\bar{\psi}_r$	space phasor of rotor flux linkages expressed in the rotor reference frame	Wb
$\bar{\psi}'_r$	space phasor of the rotor flux linkages expressed in the stator reference frame	Wb
$\bar{\psi}_{rg}$	space phasor of the rotor flux linkages expressed in the general reference frame	Wb
$\bar{\psi}_{r\psi r}$	space phasor of the rotor flux linkages expressed in the rotor-flux-oriented reference frame	Wb
$\psi_{ra}, \psi_{rb}, \psi_{rc}$	instantaneous values of the flux linkages in rotor phases ra, rb, rc respectively	Wb
ψ_{rx}, ψ_{ry}	instantaneous values of the direct- and quadrature-axis rotor flux linkage components respectively and expressed in the general or special reference frames	Wb
$\bar{\psi}_s$	space phasor of stator flux linkages expressed in the stator reference frame	Wb
$\bar{\psi}'_s$	space phasor of the stator flux linkages expressed in the rotor reference frame	Wb
$\bar{\psi}_{sg}$	space phasor of the stator flux linkages expressed in the general reference frame	Wb
$\bar{\psi}_{sm}$	space phasor of the stator flux linkages expressed in the magnetizing-flux-oriented reference frame	Wb
$\bar{\psi}_{s\psi s}$	space phasor of the stator flux linkages expressed in the stator-flux-oriented reference frame	Wb
$\psi_{sA}, \psi_{sB}, \psi_{sC}$	instantaneous values of stator flux linkages in stator phases sA, sB, sC respectively	Wb
ψ_{sd}, ψ_{sq}	instantaneous values of the direct- and quadrature-axis stator flux linkages expressed in the rotor reference frame	Wb

ψ_{sD}, ψ_{sQ}	instantaneous values of the direct- and quadrature-axis stator flux linkage components expressed in the stator reference frame	Wb
ψ_{sx}, ψ_{sy}	instantaneous values of the direct- and quadrature-axis stator flux linkage components respectively and expressed in the general or special reference frames	Wb
ω_m	angular speed of the magnetizing-flux-oriented reference frame	rad/s
ω_{mr}	angular speed of the rotor-flux-oriented reference frame	rad/s
ω_{ms}	angular speed of the stator-flux-oriented reference frame	rad/s
ω_r	angular rotor speed	rad/s
ω_{sl}	angular slip frequency	rad/s

Subscripts

A, B	upper and lower cages respectively
b	base
g	general reference frame
i	induced
m	magnetizing
n	normalized
r	rotor
ra, rb, rc	rotor phases
ref	reference
s	stator
sA, sB, sC	stator phases
x	direct-axis component in general reference frame or in special reference frames (fixed to the stator flux linkage, rotor flux linkage or magnetizing flux linkage space phasors respectively)
y	quadrature-axis component in general reference frame or in special reference frames (fixed to the stator flux linkage, rotor flux linkage or magnetizing flux linkage space phasors respectively)

Mathematical symbols

\times	cross vector product
$*$	complex conjugate

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