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HYBRID INTELLIGENT METHODS FOR PARAMETER IDENTIFICATION AND LOAD FREQUENCY CONTROL IN POWER SYSTEM

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Thesis submitted in fulfilment of the requirements
for the award of the degree of
Doctor of Philosophy in Electrical Engineering

Faculty of Electrical and Electronic Engineering
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NOVEMBER 2014

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LIST OF SYMBOLS

a	Participation factors
B	big
B	Frequency bias
c_1, c_2	acceleration coefficients
D	damping coefficient
d(n)	desired result
€	errors
G	length gain
G_{incr}	social acceleration coefficient
G_1, G_2,…, G_{incr}	random number uniformly distributed in [0, G_{incr}].
G_{in1}, G_{in2}	input gain
G_{out}	output gain
G_{tg}	turbine governor transfer function
H	equivalent inertia constant
K(s)	dynamic controller
L1, L2 L, L’	horizontal distances
LN	large negative
LP	large positive.
M(p)	parametric model
M(s)	governor–turbine dynamic model
MN	medium negative
MP	medium positive
n(t)	input noise
pg	global best positions
p_i	local best positions
p_{incr}	cognitive acceleration coefficient
p_{i1}, p_{i2}., p_{incr}	random number uniformly distributed in [0, pincr]
R	droop characteristic
r_1, r_2	random numbers between 0 and 1.
S	small

SN	small negative
SP	small positive
T_{ij}	tie-line synchronizing coefficient with area j
u(n)	desired output
u(t)	input signal
VB	very big
$v_{i1}, v_{i2}, . , v_{id}$	velocity of the i^{th} particle
V_{max}	maximum velocity value
VS	small
VVB	very very big
w(n)	adaptive transfer function configuration
X_{ij}	reactance
x(n)	input of in the implementation
$x_i, x_{i1}, x_{i2}, . , x_{id}$	position of the particle
y(n)	actual output
y(t)	system output
ym(t)	output from the parametric model
Z	zero
β,α,δ	triangular angles
Δe	change of error
Δf	frequency change
ΔP_C	supplementary control action
ΔP_L	power load change
ΔP_m	governor valve position
ΔP_P	primary control action
ΔP_{tie}	net tie-line power flow
Ψ	class for models
ω	inertia weight parameter

LIST OF ABBREVIATIONS

ACE	Area Control Error
AFRC	Automatic Frequency Ratio Control
AGC	Automatic Generation Control
AGPM	Augmented Generation Participation Matrix
AI	Artificial Intelligence
ANN	Artificial Neural Network
BES	Battery Energy Storage
CES	Capacitive Energy Storage
FD	Figure Of Demerit
GAs	Genetic Algorithms
GRC	Generation Rate Constraint
H∞	Robust Controller
HVDC	High Voltage Direct Current
IGBT	Insulated Gate Bipolar Transistor
ISE	Integral Square Error
ITAE	Integral Of Time Of Absolute Error
LFC	Load Frequency Control
LMI	Linear Matrix Inequality
LQG	Linear Quadratic Gaussian
LSE	Least Square Estimator
MLE	Maximum Likelihood Estimator
MOO	Multi-Objective Optimization
MSF	Multi-Stage Fuzzy
PD	Proportional Plus Derivative
PI	Proportional Plus Integral
PID	Proportional, Integral And Derivative
PSO	Particle Swarm Optimization
PV	Photovoltaic
RBF	Radial Biased Function
RTO	Real-Time Optimization

SA	Simulated Annealing
SePSO	Segmentation of Particle Swarm Optimization
SMES	Super Conducting Magnetic Energy Storage
SOFLC	Self Organizing Fuzzy Logic Control
SVC	Static Var Compensator
WLS	Weighted Least Squares