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## LIST OF SYMBOLS AND ABBREVIATIONS

$P_{ij}$ and $Q_{ij}$	-	Active and reactive power flow from bus- $i$ to $j$ respectively
$\Psi$	-	Augmented objective function
BBO	-	Biogeography based optimization
$x_{ij}$	-	buses- $i$ and $j$ along with FACTS device
CP	-	Capacitor placement
$\Delta\alpha_{SVC}$	-	Change in firing angle of SVC
$\Delta G_{ij}$	-	Change in line conductance between bus $i$ and $j$
$\Delta B_{ij}$	-	Change in line susceptance between bus $i$ and $j$
$\Delta Q_i$	-	Change in reactive power injection at bus- $i$ by a FACTS device
$g_k$	-	Conductance of the transmission line- $k$
$\psi$	-	Constant
$F_{ij}$	-	Elements of hybrid –F matrix
$g(x, u)$	-	Equality constraints
FACTS	-	Flexible AC transmission systems
GA	-	Genetic algorithm
$P^{mod}$	-	Habitat modification probability
HSI	-	Habitat suitability index
$\lambda$ and $\mu$	-	Immigration and emigration rates respectively
ISO	-	Independent system operator
$h(x, u)$	-	Inequality constraints
$S_{ic}$	-	Injection of apparent power at $i$ -th bus
$S_{jc}$	-	Injection of apparent power at $j$ -th bus

IPFC	- Inter line power flow controller
X & Y	- Left & right eigen vector
V & W	- Left & right singular vector
$x_c$	- Line Capacitance
$\eta_k$	- Line compensation factor in the range of (-0.8, 0.2) for $k^{th}$ FACTS device
$L_i$	- Line indicator
$x_L$	- Line Inductance
LP	- Linear programming
LS	- Load shedding
$Q_{Gi}^{\min}$ and $Q_{Gi}^{\max}$	- Lower and upper limit reactive power generation at bus- $i$ respectively
$V_i^{\min}$ and $V_i^{\max}$	- Lower and upper limits of voltage magnitude at bus- $i$ respectively
$E^{\max}$	- Maximum emigration rate
$I^{\max}$	- Maximum immigration rate
$m^{\max}$	- Maximum mutation rate
$Iter^{\max}$	- Maximum number of iterations
$P^{\max}$	- Maximum probability
$S^{\max}$	- Maximum species in the habitat
$Q_I$	- Mega var injection
MVAR	- Mega volt ampere reactive
$m(s)$	- Mutation rate for habitat possessing S species
$L_k$	- Number of a line, where $k^{th}$ FACTS device is to be located
$neh$	- Number of elite habitats
$nf$	- Number of FACTS devices

$nh$	-	Number of habitats
$nload$	-	Number of load buses
$\Phi(x,u)$	-	Objective function
PSO	-	Particle swarm optimization
$V_{sh}$	-	Positive sequence shunt voltage
$P^s(t)$	-	Probability that the habitat contains exactly S species at time $t$
PM	-	Proposed method
$X_{SVC}$	-	Reactance of SVC
$x_F$	-	Reactance of the FACTS device
$x_{ij}$	-	Reactance of the transmission line between buses- $i$ and $j$
$Q_k$	-	Reactive power at k-th bus
$Q_{sh}$	-	Reactive power at shunt connected source
$Q_{ji}$	-	Reactive power flow from $j^{\text{th}}$ bus to $i^{\text{th}}$ bus
$Q_{Gi}$	-	Reactive power generation at bus- $i$
$Q_{Fi}$	-	Reactive power supplied by the FACTS device at bus- $i$
$Q_F^k$	-	Reactive power support by $k^{\text{th}}$ FACTS device in MVAR
$Q_v$	-	Reactive power voltage
$P_{sh}$	-	Real power flow at shunt voltage source
$P_{ji}$	-	Real power flow from $j^{\text{th}}$ bus to $i$ bus
$P_v$	-	Real power voltage
$V_{se}$	-	Series connected voltage source
$\theta_{se}$	-	Series converter angle in IPFC
$V_{se}$	-	Series converter voltage of IPFC

$Z_{se}$	- Series source impedance
$\alpha G$	- Set of generator buses
$\alpha L$	- Set of load buses
$Q(V, \delta)$	- Set of reactive power expressions at PQ buses
$P(V, \delta)$	- Set of real power expressions at PV and PQ buses
$Q^{sp}$	- Set of specified reactive powers at PQ buses
$P^{sp}$	- Set of specified real powers at PV and PQ buses
$G_{sh}$	- Shunt converter conductance
$B_{sh}$	- Shunt converter susceptance
$Q_{sh}$	- Shunt converter reactive power
$P_{sh}$	- Shunt converter real power
$Z_{sh}$	- Shunt source impedance
SA	- Simulated annealing
$\dot{P}^s$	- Species count probability
$S$	- Species in the habitat
V0	- Starting voltage at a bus
$-jX_c$	- Static reactance
$-jX_c$	- Static reactance
STATCOM	- Static synchronous compensator
SSSC	- Static synchronous series compensator
SVC	- Static VAR compensator
$Y_{LL} \& G_{LG}$	- Sub matrices of the Y- bus matrix
$SIV$	- Suitability index variable
SVSI	- Sum of voltage stability index
$B_{SVC}$	- Susceptance of SVC
$\alpha^i_{SVC}$	- SVC firing angle at $i^{\text{th}}$ iteration
$Q_{svc}$	- SVC reactive power

$B_{svc}$	- SVC susceptance
$B_{svc}^i$	- SVC susceptance at $i^{\text{th}}$ iteration
$P_L$	- System real power loss
Subscript $i$ and $j$	- Terminal buses of line- $m$
TCPAR	- Thyristor controlled phase angle regulator
TCSC	- Thyristor controlled series compensator
$n$	- Total number of species in the habitat
$T_k$	- Type of $k^{\text{th}}$ FACTS device
UPFC	- Unified power flow controller
$\alpha_{svc}$	- Variable firing angle of SVC
$u$	- Vector of control or independent variables
$x$	- Vector of dependent variables
$\delta_{ij}$	- Voltage angle between buses- $i$ and $j$
$V_{di}$	- Voltage deviation at bus- $i$
$V_i$	- Voltage flow at $i$ -th bus
$V_i$ and $V_j$	- Voltage magnitude at buses- $i$ and $j$ respectively
VP	- Voltage profile
VR	- Voltage regulators
VS	- Voltage stability
RVI	- voltage stability index
$w_1$ and $w_2$	- Weight constants