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LIST OF SYMBOLS AND ABBREVIATIONS

SYMBOLS

$T(t)$	-	Reactor temperature
T_{amb}	-	Ambient Temperature
T^{set}	-	Reactor temperature set point
$m_M(t)$	-	Monomer mass
$\dot{m}_M^{in}(t)$	-	Monomer Feed Rate
Q_{rea}	-	Reaction heat
ΔH	-	Reaction enthalpy
$m_p(t)$	-	Polymer mass
m_c	-	Mass of coolant
m_w	-	Mass of water
MW_M	-	Molecular weight of monomer
$C_{p,M}$	-	Specific heat of Monomer at constant pressure
$C_{p,C}$	-	Specific heat of Coolant at constant pressure
$C_{p,P}$	-	Specific heat of Polymer at constant pressure
$C_{p,W}$	-	Specific heat of Water at constant pressure
U	-	Overall heat transfer coefficient
A	-	Jacket heat transfer area
$G(\theta^*)$	-	Actual Plant model
$(UA)_{loss}$	-	Heat loss coefficient
T_j^{out}	-	Coolant outlet temperature

\dot{m}_c	- Coolant rate
T_j^{in}	- Coolant inlet temperature
θ_1	- Transport delay in jacket
θ_2	- Transport delay recirculation loop
τ_p	- Heating/cooling time constant
$K_p(c)$	- Heating/cooling function
$m_M^{in,max}$	- Maximum monomer feed rate
$[t_{M,0}^{in}, t_{M,1}^{in}]$	- Time interval of feed period for polymer A and polymer B
$[t_{M,2}^{in}, t_{M,3}^{in}]$	- Time interval of feed period for polymer B
T_{inlet}	- Inlet Temperature
T_{steam}	- Steam temperature
$c(t)$	- Control valve position
R_p	- Polymerization rate
$1/h_f$	- Fouling factor
σ	- Standard Deviation
i	- Impurity factor
k	- First-order kinetic constant
$k_0, k_1, k_2, E,$	- Constants
$c_0, c_1, c_2, c_3,$	
a_0	
R	- Natural gas constant
μ	- Batch viscosity
ρ_M	- Density of Monomer
ρ_P	- Density of Monomer

ρ_c	- Density of Coolant
B_1	- Reactor bottom area
P	- Jacket perimeter
B_2	- Jacket bottom area
h	- Film heat transfer co-efficient
d_0, d_1	- Constants
μ_{wall}	- Wall viscosity
T_j	- Average cooling jacket temperature
T_{wall}	- Wall temperature
t^{heat}	- Time instant when the monomer feed starts
X_i	- Inputs to the ANN
W_i	- Weights to the Inputs
b	- Bias
y	- Plant output
$f(Y)$	- Output of the sigmoid activation function
V	- Error matrix
e_q	- Difference in process and network output
t_q	- Process output
a_q	- Network output
$X(k)$	- Weight matrix at i^{th} instant
$J(X_k)$	- Partial derivative of error with respect to weights
$C_1(s)$	- Outer loop controller
$C_2(s)$	- Inner loop controller
$G_1(s)$	- Outer loop process
$G(s)$	- Overall process
$G_2(s)$	- Inner loop process

$T^*(t)$	-	Desired reactor temperature
d_1, d_2	-	Disturbances
T_j^*	-	Desired cooling jacket temperature
T_j^{set}	-	Coolant temperature set point
u	-	Plant input
$\theta(t)$	-	Parameter estimate
$C(\theta_c(t))$	-	Control law
f	-	Auxiliary variable
$\hat{x}_{k/k-1}$	-	Mean of predicted state
θ^*	-	Unknown parameter vector
n	-	Number of states
$W_m^{(i)}$	-	Weights to the Sigma Points
$x^{(i)}$	-	Sigma points
α, β	-	Parameters to calculate the sigma points
κ	-	Secondary scaling factor
\hat{P}_k	-	Covariance of the predicted state
Q	-	Covariance of process noise
P_{xz}	-	Covariance of residue
$\hat{z}_{k/k-1}$	-	Mean of measured output
$G(\theta(t))$	-	Estimated plant model
P_{zz}	-	Covariance of innovation
K_k	-	Kalman Gain
\hat{P}_k	-	Updated covariance
\hat{x}_k	-	Updated state
R	-	Covariance of measurement noise
θ_c	-	Gain vector

ABBREVIATIONS

ANN	-	Artificial Neural Network
CC	-	Cascade Controller
EKF	-	Extended Kalman Filter
ERN	-	Externally Recurrent Networks
GMC	-	Generic Model control
IAE	-	Integral Absolute Error
ISE	-	Integral Square Error
LTI	-	Linear time-invariant
MSE	-	Mean square error
MLP	-	Multi Layer Perceptron
MNN	-	Multiple Neural Network
PVC	-	Poly Vinyl Chloride
PID	-	Proportional-Integral-Derivative
RNN	-	Recurrent Neural Networks
SISO	-	Single-input Single-output
UKF	-	Unscented Kalman Filter