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LIST OF SYMBOLS AND ABBREVIATIONS

Q_β, Q_η	Covariance matrices
x	True state variable
$\hat{x}(k/k)$	Updated state estimates
$\hat{x}(k/k-1)$	Predicted state estimates
$P(k/k)$	Updated error covariance matrix
$P(k/k-1)$	Predicted error covariance matrix
y(k)	Measured variables
u(k)	Process inputs
v(k)	Measurement errors
w(k)	State noise vectors
A	State transition matrix (continuous domain)
B	Input matrix (continuous domain)
C	Measurement matrix
F	Jacobian matrix
$h_i(z(k))$	Grade of membership
$K_i(k)$	Kalman gain matrix
$P_i(k/k-1)$	Error covariance matrix of predicted state estimate
$P_i(k/k)$	Error covariance matrix of updated state estimate
β and η	Additional linear states
N_P	Prediction horizon
N_c	Control horizon
$y_m(k)$	Measured output
W_E	Error weighting matrix
W_U	Input move weight matrix

CSTR-I

C_A	Concentration (mol/L)
T	Temperature (K)
Q	State noise covariance matrices
R	Measurement noise covariance matrices
q_c	Coolant flow rate (L/min)
q	Feed flow rate (L/min)
C_{A0}	Feed concentration (mol/L)
T_0	Feed temperature (K)
T_{c0}	Inlet coolant temperature (K)
V	CSTR volume (L)
hA	Heat transfer term (cal/(min.K)
k_0	Reaction rate constant (min^{-1})
E/R	Activation energy term (K)
$-\Delta H$	Heat of reaction (cal/mol)
ρ, ρ_c	Liquid density (g/L)
C_p, C_{pc}	Specific heats (g.K)

CSTR-II

A	Area for heat exchanger (m^2)
C_A	Concentration of A in reactor ($kgmol/m^3$)
C_{Af}	Concentration of A in feed stream ($kgmol/m^3$)
C_p	Heat capacity (energy/mass * temperature)
F	Volumetric flow rate (volume/time)
k_0	Pre-exponential factor ($time^{-1}$)
R	Ideal gas constant (energy/ mol * temperature)
r	Rate of reaction per unit volume (mol/volume * time)
t	Time (hrs)
T	Reactor temperature (Deg.k)

T_f	Feed temperature (Deg.k)
T_j	Jacket temperature (Deg.k)
T_{ref}	Reference temperature (Deg.k)
U	Overall heat transfer coefficient (energy/ (time * area * temperature))
V	Reactor volume (m^3)
ΔE	Activation energy (energy/mol)
ΔH	Heat of reaction (energy/mol)
ρ	Density (mass/volume)

Greek Letter

Φ	State transition matrix (Discrete domain)
Γ	Input coupling matrix (Discrete domain)
Υ	Disturbance coupling matrix
μ	Mean of estimation error
σ	Standard deviation of estimation error
η	Output disturbance vector
β	Input disturbance vector

Abbreviations

ASFKF	Augmented State Fuzzy Kalman Filter
CSTR	Continuous Stirred Tank Reactor
DMC	Dynamic Matrix Control
EDMC	Extended Dynamic Matrix Control
EKF	Extended Kalman Filter
FKF	Fuzzy Kalman Filter
LMPC	Linear Model Predictive Control

MBPC	Model Based Predictive Control
MIMO	Multi Input Multi Output
MPC	Model Predictive Controller
NARX	Nonlinear Auto Regressive eXogenous
NMPC	Nonlinear Model Predictive Controller
T-S	Takagi-Sugeno