AN OPTIMIZATION ALGORITHM FOR LOWER ORDER MODEL FORMULATION OF SISO SYSTEMS

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PREFACE

The analysis and synthesis of higher order models are complicated and are not desirable on economic and computational considerations. To circumvent the computational complexities, this Book introduces lower order models employing proposed techniques to determine an equivalent lower dimensional approximant for the considered original higher order model. The computed lower order model preserves the characteristics of the original higher order model.

Firstly, the linear time invariant single input single output continuous systems are considered to investigate the efficiency of the proposed lower order model formulation approach. For this, the given linear time invariant higher order system represented in the form of transfer function is adopted to get a weighted average lower order transfer function and its coefficients are tuned suitably with the help of proposed improved water swirl algorithm along with transient and steady state gain adjustments. The lower order model is formed on an error based criterion. Also the single input single output linear time invariant discrete systems are dealt for lower model order formulation with the help of proposed approach. The lower order models minimize the computational complexities for the process of output stabilization compared with higher order models.

Secondly, design procedures for PID controller tuning are proposed based on lower order model formulated for single input single output continuous systems and single input single output discrete systems. PID controller parameters are evaluated for the computed second order model to meet the desired design specifications by using Pole-Zero Cancellation and simulation method. Continuous and Discrete PID controllers are designed by employing the proposed computed lower second order model and it retains the desired performance specifications.Performance of computed PID controller with original higher order continuous and discrete system and proposed lower second order approximant is demonstrated with illustrative examples from the literature.

Algorithms are presented for all the contributions provided in this book with illustrations and results

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LIST OF SYMBOLS

ε	-	Error
τ	-	Time in secs to be chosen for the comparison of original and computed lower order models
ζ	-	Damping ratio
ωn	-	Undampednatural frequency
$Y(s)$	-	Laplace transformation of output function
$R(s)$	-	Laplace transformation of input function
$E(s)$	-	Laplace transformation of error function
Θ	-	Velocity
x	-	n dimensional state vector
u	-	q dimensional control vector
y	-	r dimensional output vector
K_p	-	Proportional
K_i	-	Integral
K_d	-	Derivative
σ	-	vortex core radius.
K	-	Feedback coefficient
s	-	Laplace variable
R_s	-	Laplace transform of the input variable
Y_s	-	Laplace transform of the output variable

LIST OF ABBREVIATION

PSO	-	Particle Swarm Optimization
GA	-	Genetic Algorithm
SISO	-	Single Input Single Output
LTICS	-	Linear Time Invariant Continuous System
LTIDS	-	Linear Time Invariant Discrete System
IWSA	-	Improved Water Swirl Algorithm
MIMO	-	Multi Input Multi Output
WA	-	Weighted Average
WSA	-	Water Swirl Algorithm
SA	-	Simulated Annealing
ACO	-	Ant Colony Optimization
PSA	-	Particle Swirl Algorithm
BFA	-	Bacterial Foraging Algorithm
FSA	-	Fish Swarm Algorithm
AIS	-	Artificial Immune System
HAS	-	Harmony Search Algorithm
IWO	-	Invasive Weed Optimization
ABC	-	Artificial Bee Colony
BBO	-	Biogeography-Based Optimization
IWD	-	Intelligent Water Drop
TF	-	Transfer function
TG	-	Transient gain
SSG	-	Steady state gain
LT	-	Linear transformation

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