Nomenclature

General conventions

Variable	Font	Example
Scalar	italic letter	a
Continuous time vector	italic, bold face letter	$\boldsymbol{a}$
Discrete time vector	bold face letter	$\mathbf{a}$
Scalar	italic capital letter	A
Continuous time matrix	italic, bold face capital letter	$\boldsymbol{A}$
Discrete time matrix	bold face capital letter	$\mathbf{A}$
Identity matrix	bold face capital I	$\mathbf{I}$
Zero matrix or vector	bold face capital 0	$\mathbf{0}$
Matrix consisting of sub-matrices ij	bold face capital	$\{\mathbf{A}^{(ij)}\}$

Common operators

Laplace operator $\mathcal{L}\{\,.\,\}$

Assuming a time variant function $x(t)$ defined for $t \geq 0,\ t \epsilon \mathbb{R}$, integrable for $(0, \infty)$, and with the limited growth $|x(t)| \leq K\, e^{ct}$, the Laplace operator $\mathcal{L}\{\,.\,\}$ is defined by

$$X(s) = \mathcal{L}\{\, x(t) \,\} = \int_0^\infty e^{-s\,t}\, x(t)\, dt$$

with $s = \delta + j\omega$ being a complex variable and $X(s)$ the Laplace transformed function, respectively. K and c are constants [Bronstein, 1989].

z-transformation operator $\mathcal{Z}\{\,.\,\}$

Given the discrete time sequence $x(k)$ for $k \geq 0,\ k \epsilon \mathbb{N}$, the z-transformation operator $\mathcal{Z}\{\,.\,\}$ can be defined as

$$X(z) = \mathcal{Z}\{\, x(k) \,\} = \sum_{k=0}^{\infty} x(k)\, z^{-k}$$

with $z = \alpha + j\beta$ being a complex variable and $X(z)$ the z-transformed function, respectively. This sequence converges for all values of z with $|z| > R$ absolutely, if the in-equation $|x(k)| < K\, R^k$ is satisfied. K and R are constants [Jörgl, 1994].

Expectation operator $\mathcal{E}\{\,.\,\}$

For a discrete time, ergodic, stochastic and scalar process $x(k)$ the expectation operator $\mathcal{E}\{\,.\,\}$ is defined as [Schlitt, 1992]

$$\mathcal{E}\{\,x(k)\,\} = \lim_{N\to\infty} \frac{1}{N} \sum_{k=0}^{N-1} x(k).$$

Important symbols

Symbols of the continuous time, nonlinear model

$\mathbf{u}_d$	digital control voltages
$\boldsymbol{u}_a$	analogue control voltages
$\boldsymbol{u}_s$	switched voltages for amplifier
$\boldsymbol{i}$	coil currents
$\boldsymbol{i}_m$	measured coil currents
$\mathbf{i}_d$	sampled coil currents
$\boldsymbol{z}_b$	rotor position in bearing coordinates
$\boldsymbol{z}_s$	rotor position in sensor coordinates
$\boldsymbol{z}_m$	measured rotor position in sensor coordinates
$\mathbf{z}_d$	sampled rotor position in sensor coordinates
$\boldsymbol{w}$	position set points
$\boldsymbol{v}$	measurement noise
$\boldsymbol{F}_a$	actuator forces

Symbols of the electrical signal path

Φ	magnetic flux
μ	magnetic permeability
A	cross section area of magnetic path
l	length of magnetic path
B	magnetic induction
H	magnetic field strength
$\mathcal{R}$	magnetic reluctance
N	number of coil windings
u	voltage
i	coil current
r	Ohmic resistance

Symbols for the linear active magnetic bearing (AMB)

K_s	position stiffness of an AMB
K_i	current gain of an AMB

Symbols of the continuous time linear state space model

n_s	number of system states
n_i	number of system inputs
n_o	number of system outputs
$\boldsymbol{A}$	continuous time system matrix
$\boldsymbol{B}$	continuous time control matrix
$\boldsymbol{C}$	continuous time measurement matrix
$\boldsymbol{x}$	continuous time system states
$\boldsymbol{u}$	continuous time control variable
$\boldsymbol{y}$	continuous time output variable
$\boldsymbol{v}$	continuous time measurement noise
$\boldsymbol{Q}$	covariance matrix for measurement noise

Symbols of the discrete time linear state space model

T_s	Sampling time
ν_i	structural indices
$\mathbf{A}$	discrete time system matrix
$\mathbf{B}$	discrete time control matrix
$\mathbf{C}$	discrete time measurement matrix
$\mathbf{K}$	Kalman filter matrix
$\mathbf{x}$	discrete time system states
$\mathbf{u}$	discrete time control variable
$\mathbf{y}$	discrete time output variable
$\mathbf{w}$	discrete time set point
$\boldsymbol{\eta}$	system noise
$\boldsymbol{\xi}$	measurement noise
$\mathbf{R}_i$	covariance matrices

Symbols of the adaptation algorithm

n_p	number of parameters to be estimated
$\mathbf{p}$	parameter vector
$\mathbf{P}$	parameter covariance matrix
$\mathbf{L}$	error adaptation matrix
$\mathbf{W}$	partial derivative of the estimated states with respect to the parameter vector
$\mathbf{V}_k$	partial derivative of the estimated system output with respect to the parameter vector
$\mathbf{M}_k$	partial derivative of the predictor with respect to the parameter vector
$\boldsymbol{\Psi}$	gradient matrix
$\boldsymbol{\varepsilon}$	prediction error
δ	forgetting control parameter
ρ	forgetting factor
σ^2	prediction error variance