

University of Groningen

Model reduction for controller design for infinite-dimensional systems

Opmeer, Mark Robertus

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:
2006

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Opmeer, M. R. (2006). *Model reduction for controller design for infinite-dimensional systems*. [Thesis fully internal (DIV), University of Groningen]. s.n.

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

List of Notation

Symbol	Short description	Page
A	state operator	8
\mathbf{A}	state function	10
\mathfrak{A}	resolvent of a discrete-time system	12
\mathfrak{a}	pseudoresolvent (of a continuous-time system)	124
B	input operator	8
\mathcal{B}	Banach space	
\mathbb{B}	behavior	7
\mathcal{B}	input map	8
\mathbf{B}	input function	10
\mathfrak{B}	incoming wave function of a discrete-time system	12
\mathfrak{b}	incoming wave function of a continuous-time system	124
$\vec{B}(\cdot, \cdot)$	directed gap ball	95
$B(\cdot, \cdot)$	gap ball	95
C	output operator	8
\mathbb{C}	set of complex numbers	
\mathbb{C}_σ^+	open right half-plane $\{s \in \mathbb{C} : \text{Res} > \sigma\}$	
\mathcal{C}	output map	8
\mathbf{C}	output function	10
\mathfrak{C}	outgoing wave function of a discrete-time system	12
\mathfrak{c}	outgoing wave function of a continuous-time system	124

Symbol	Short description	Page
d	Dirichlet form	133
D	feedthrough operator	8
\mathbb{D}	open unit disc $\{z \in \mathbb{C} : z < 1\}$	
\mathbb{D}_r	open disc $\{z \in \mathbb{C} : z < r\}$	
$\overline{\mathbb{D}}$	closed unit disc $\{z \in \mathbb{C} : z \leq 1\}$	
$\overline{\mathbb{D}}_r$	closed disc $\{z \in \mathbb{C} : z \leq r\}$	
\mathcal{D}	input-output map	9
D	transfer function	11
\mathfrak{D}	characteristic function of a discrete-time system	13
\mathfrak{d}	characteristic function of a continuous-time system	124
F	component of an admissible feedback pair	33
F	feedback operator associated with the Riccati equation	49
f	component of an admissible feedback pair	147
F^{\min}	optimal cost feedback operator	47
G	component of an admissible feedback pair	33
\mathfrak{g}	component of an admissible feedback pair	147
G	holomorphic function	
\mathcal{H}	(separable) Hilbert space	
\mathcal{H}	Hankel map	9
H^2	Hardy space	169
H^∞	Hardy space	169
H^s	Sobolev space (only in Chapter 12)	
H_0	Space of functions holomorphic at zero	61
\mathcal{I}^+	minimizing operator	45
J	cost function	43
\mathcal{K}	subspace of a Hilbert space	
K	admissible feedback function	81

Symbol	Short description	Page
L	strongly elliptic operator	133
L_F	Laurent operator of the function F	172
$\mathcal{L}(\mathcal{B}_1, \mathcal{B}_2)$	set of bounded linear operators from \mathcal{B}_1 to \mathcal{B}_2	
$\mathcal{L}(\mathcal{B})$	set of bounded linear operators from \mathcal{B} to itself	
$l^2(J, \mathcal{H})$	set of square summable sequences $J \subset \mathbb{Z} \rightarrow \mathcal{H}$	
$L^2(J, \mathcal{H})$	set of square summable functions $J \subset \mathbb{R} \rightarrow \mathcal{H}$	
M	Möbius operator	140
M	component of a right factor	62
\tilde{M}	component of a left factor	62
N	component of a right factor	62
\tilde{N}	component of a left factor	62
q	component of a control Riccati triple	49
q^{\min}	optimal cost sesquilinear form	46
Q	solution of the control algebraic Riccati equation	49
Q^{\min}	optimal cost operator	47
\mathbb{R}	set of real numbers	
\mathbb{R}^+	set of nonnegative real numbers $\{x \in \mathbb{R} : x \geq 0\}$	
\mathbb{R}^-	set of negative real numbers $\{x \in \mathbb{R} : x < 0\}$	
$r(T)$	spectral radius of the operator T	
r_A	radius of convergence of series for A	10
r_B	radius of convergence of series for B	10
r_C	radius of convergence of series for C	10
r_D	radius of convergence of series for D	11
s	component of a control Riccati triple	49
S	(often) system operator	8
S	sensitivity operator associated with the Riccati equation	49

Symbol	Short description	Page
\mathbb{T}	unit circle $\{z \in \mathbb{C} : z = 1\}$	
T_F	Toeplitz operator of the function F	172
\mathcal{U}	input space (a separable Hilbert space)	7
$\mathcal{V}(x_0)$	set of stable input-output pairs	44
\mathcal{X}	state space (a separable Hilbert space)	7
X	component of a left Bezout factor	62
\tilde{X}	component of a right Bezout factor	62
\mathcal{Y}	output space (a separable Hilbert space)	7
Y	component of a left Bezout factor	62
\tilde{Y}	component of a right Bezout factor	62
\mathbb{Z}	set of integers	
\mathbb{Z}^+	set of non-negative integers $\{n \in \mathbb{Z} : n \geq 0\}$	
\mathbb{Z}^-	set of negative integers $\{n \in \mathbb{Z} : n < 0\}$	
δ	gap metric	89,92
$\vec{\delta}$	directed gap	89,92
Λ	set of definition of a resolvent linear system	124
Λ_E	exponential region	126
Σ	system	
\dagger	$f^\dagger(s) := f(\bar{s})^*$	16
\wedge	\hat{h} is the Z-transform or Laplace transform of h	