

Contents

	Introduction	Martin Grötschel and Volker Mehrmann	ix
<hr/>			
A	Life sciences	Peter Deuffhard and Christof Schütte	1
A1	Mathematics cures virtual patients	Peter Deuffhard, Ralf Kornhuber, Oliver Sander, Anton Schiela and Martin Weiser	7
	SHOWCASE 1	Mathematics without pain	Marcus Weber and Peter Deuffhard 26
A2	Advanced mathematical modeling in systems biology	Alexander Bockmayr, Heike Siebert, Susanna Röblitz, Christof Schütte and Peter Deuffhard	29
	SHOWCASE 2	Mathematical secrets of the female cycle	Susanna Röblitz and Peter Deuffhard 46
A3	Design of functional molecules	Christof Schütte, Peter Deuffhard, Frank Noé and Marcus Weber	49
	SHOWCASE 3	Information-based medicine	Christof Schütte and Tim Conrad 66
	SHOWCASE 4	Overcoming the curse of dimension in quantum chemistry	Harry Yserentant 68
<hr/>			
B	Networks	Martin Grötschel, Rolf H. Möhring and Martin Skutella	71
B1	Mathematics for telecommunications	Frank Aurzada, Andreas Bley, Andreas Eisenblätter, Hans-Florian Geerdes, Mijail Guillemard, Gitta Kutyniok, Friedrich Philipp, Christian Raack, Michael Scheutzow and Axel Werner	75
	SHOWCASE 5	Automated radio network optimization	Andreas Eisenblätter and Hans-Florian Geerdes 90
B2	Towards better solutions in logistics with mathematics	Ralf Borndörfer, Rolf H. Möhring and Martin Skutella	93

- SHOWCASE 6 Routing AGVs in a container terminal Elisabeth Lübbecke and Rolf H. Möhring 108
- SHOWCASE 7 Routing ships through the Kiel Canal Elisabeth Lübbecke and Rolf H. Möhring 110
- B3 Traveling efficiently with mathematics Ralf Borndörfer, Olga Heismann, Marika Karbstein, Christian Liebchen, Rolf Möhring, Andris Möller and Werner Römisch 113
- SHOWCASE 8 Line planning in Potsdam Ralf Borndörfer and Marika Karbstein 130
- SHOWCASE 9 Optimizing periodic timetables in public transport Christian Liebchen and Rolf H. Möhring 132
- B4 A Jack of all trades? Solving stochastic mixed-integer nonlinear constraint programs Thomas Arnold, Timo Berthold, Stefan Heinz, Stefan Vigerske, René Henrion, Martin Grötschel, Thorsten Koch, Caren Tischendorf and Werner Römisch 135
- SHOWCASE 10 SCIP Optimization Suite Timo Berthold and Stefan Heinz 148
-
- C Production Carsten Carstensen, Michael Hintermüller, Dietmar Hömberg and Fredi Tröltzsch 151
- C1 Mathematical modeling of multiscale problems Wolfgang Dreyer and Barbara Wagner 155
- SHOWCASE 11 Wafer production and energy storage – Two technologies, same mathematics Wolfgang Dreyer 168
- C2 Nonlinear programming with applications to production processes Torsten Bosse, Andreas Griewank, René Henrion, Dietmar Hömberg, Chantal Landry, Hernan Leövey and Werner Römisch 171
- C3 Phase transformation and separation in solids Dorothee Knees, Ralf Kornhuber, Christiane Kraus, Alexander Mielke and Jürgen Sprekels 189
- SHOWCASE 12 The mathematics of nanostructuring free surfaces Barbara Wagner 204
- C4 PDE-constrained optimization with industrial applications Michael Hintermüller, Dietmar Hömberg, Olaf Klein, Jürgen Sprekels and Fredi Tröltzsch 207
- SHOWCASE 13 Growth of semiconductor bulk single crystals Olaf Klein and Jürgen Sprekels 224
- SHOWCASE 14 How math reduces noise Jörg Liesen, Christian Mehl, Volker Mehrmann and Reinhard Nabben 226
-

- D Electronic and photonic devices Volker Mehrmann, Alexander Mielke and Frank Schmidt 229
- D1 Electronics Caren Tischendorf, Volker Mehrmann and Kersten Schmidt 233
- D2 Mathematics for optoelectronic devices Annegret Glitzky, Alexander Mielke, Lutz Recke, Matthias Wolfrum and Serhiy Yanchuk 243
- D3 Nanophotonics and nonlinear fiber optics Shalva Amiranashvili, Uwe Bandelow, Mark Blome, Sven Burger, Frank Schmidt, Kersten Schmidt and Lin Zschiedrich 257
- SHOWCASE 15 Semiconductor lasers for information processing Mindaugas Radziunas 276
- SHOWCASE 16 Optics of thin film solar cells Daniel Lockau, Martin Hammerschmidt, Mark Blome and Frank Schmidt 278
-
- E Finance Ulrich Horst 281
- E1 Securitization, optimal control and forward-backward stochastic differential equations Gregor Heyne and Peter Imkeller 285
- E2 Affine and beyond affine processes in finance: LIBOR modelling and stochastic volatility Peter Friz, Martin Keller-Ressel and Antonis Papapantoleon 299
- SHOWCASE 17 Expiry-wise Heston LIBOR model John Schoenmakers 314
- E3 Stochastic simulation methods for optimal stopping and control – Towards multilevel approaches Dirk Becherer and John Schoenmakers 317
- SHOWCASE 18 Active and passive order management Peter Bank and Ulrich Horst 332
-
- F Visualization Konrad Polthier, John Sullivan, Günter M. Ziegler and Hans-Christian Hege 335
- F1 Geometry processing Konrad Polthier, Alexander Bobenko, Klaus Hildebrandt, Ralf Kornhuber, Christoph von Tycowicz, Harry Yserentant and Günter M. Ziegler 341
- SHOWCASE 19 MATHEON Buddy Bear – An application of discrete conformal mappings Alexander I. Bobenko and Stefan Sechelmann 356
- F2 Image processing Hans Lamecker, Hans-Christian Hege, Karsten Tabelow and Jörg Polzehl 359
- SHOWCASE 20 Surgery planning for hearing implants Hans Lamecker 377
- SHOWCASE 21 Towards in-vivo histology Karsten Tabelow and Jörg Polzehl 378

- F3 Mathematical visualization John M. Sullivan, Ulrich Pinkall and Konrad Polthier 381
SHOWCASE 22 Mathematics in Hollywood Felix Kälberer, Matthias Nieser and
Konrad Polthier 393
-

- ZE Education Jürg Kramer, Thomas Lange, Brigitte Lutz-Westphal, Sebastian Tappert
and Elke Warmuth 395

SHOWCASE 23 The educational chain in mathematics Jürg Kramer and
Elke Warmuth 410

SHOWCASE 24 The German Center for Mathematics Teacher Education (DZLM)
Jürg Kramer and Thomas Lange 412

- ZO Improving the public image of math – Public relations, press work and school activities
Rudolf Kellermann and Katja Biermann 415

SHOWCASE 25 The mathematics Advent calendar Katja Biermann, Martin Grötschel
and Brigitte Lutz-Westphal 436

SHOWCASE 26 MATHEathLION: Fast minds – fast legs Martin Grötschel and
Rudolf Kellermann 438

Index 441

Authors 449