Curriculum Vitae

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Name	Rafael Grytz, PhD
Date of Birth	December 8, 1976
Citizenship	Germany
Affiliation	Research Associate, Bioengineering Devers Eye Institute Research Laboratories 1225 NE 2nd Avenue Portland, Oregon 97232
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Academic Qualifications

Dec. 2008 **Dr.-Ing. (Ph.D.)**, graduation with distinction*
Civil Engineering, Ruhr-University Bochum, Germany
Thesis: Computational Modeling and Remodeling of Human Eye Tissues as Biomechanical Structures at Multiple Scales. Shaker Verlag, Aachen ISBN 978-3-8322-7958-5.

Oct. 2002 **Dipl.-Ing. (M.S.)**, graduation with distinction*
Civil Engineering, Ruhr-University Bochum, Germany

*Both projects were honored with awards (see award section).

Research Interests

Ocular mechanics and mechanobiology with emphasis on multi-scale approaches:

- Computational and experimental models for understanding ocular disease development and progression that support the development of new diagnostics, therapeutics and medical devices
- Computational multi-scale models for investigating the biomechanical mechanisms that are involved in the pathophysiology of glaucoma
- Predictive computational models for elucidating tissue growth and remodeling mechanisms in response to biological and mechanical stimuli at different length scales
- Microstructure based constitutive models, and experimental and inverse parameter identification techniques for deciphering the origin of elasticity in eye tissues

Work Experience

Aug. 2010 – present	Research Associate, Bioengineering, Ocular Biomechanics Laboratory, Devers Eye Institute, Portland, OR, USA
Apr. 2009 – July 2010	Post Doctoral Research Fellow, Ocular Biomechanics Laboratory, Devers Eye Institute, Portland, OR, USA
Jan. 2003 – Mar. 2009	Teaching/Research Assistant, Institute for Structural Mechanics, Ruhr-University Bochum, Germany

Awards

June 2010 Award of the "Gesellschaft der Freunde der Ruhr-Universität Bochum", award for outstanding interdisciplinary research work granted by the Ruhr-University Research School (4000€).

Nov. 2009 Deutscher Studienpreis, nationwide award for substantial and innovative research work with outstanding relevance for the society granted by the Köber-Stiftung (3000€).

Nov. 2003 Preis der Studierenden, award for excellent performance as a student granted by the Department of Civil Engineering, Ruhr-University Bochum, Germany (500€).

Memberships of Professional Organizations

since 2012 US Association of Computational Mechanics (USACM)

since 2012 International Society for Eye Research (ISER)

since 2011 American Society of Mechanical Engineering (ASME)

since 2008 Association for Research in Vision and Ophthalmology (ARVO)

since 2007 German Association for Computational Mechanics (GACM)

Professional Activities

present Active reviewer for international journals:
- Biomechanics and Modeling in Mechanobiology
- Computer Methods in Biomechanics and Biomedical Engineering
- Journal of Biomechanics
- Journal of Biomechanical Engineering
- Investigative Ophthalmology & Visual Science
- Experimental Eye Research
- Ophthalmic and Physiological Optics

present Organizer, Soft Tissue Elasticity Across Different Length Scales, 10th World Congress on Computational Mechanics (WCCM2012), São Paulo, Brazil.

Aug. 2010 Chair, Session on Biomechanical Test of the Soft Tissue, 6th World Congress of Biomechanics (WCB), Singapore.

Feb. 2009 Organizer and Chair, Young Researchers' Minisymposium on Computational modeling of biological tissues in physiological and pathophysiological conditions. 80th Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM), Gdańsk, Poland.

Sep. 2009 Organizer and Chair, Minisymposium on Biological Soft Tissues: Modelling and Simulation. 3nd German Association for Computational Mechanics Colloquium (GACM), Hanover, Germany.

Oct. 2007 Organizer and Chair, Minisymposium on Modeling Dissipative Effects in Soft Biological Tissues. 2nd German Association for Computational Mechanics Colloquium (GACM), Munich, Germany.

Sep. 2006 Participant, CISM-IUTAM Summer School, "Biomechanical modeling at the molecular, cellular and tissue levels", Udine, Italy.

June 2003 Participant, CISM-IUTAM Summer School, "Chemo-mechanical Coupling in Porous Media–Geomechanics and Biomechanics", Udine, Italy.

Invited Lectures

June 2011 Advanced Computational Analysis in Ophthalmology Research, Growth and Remodeling of the Lamina Cribrosa in Early Glaucoma. University of Pittsburgh, Pittsburgh, Pennsylvania.

May 2011 Lamina Cribrosa Thickening in Early Glaucoma Predicted by a Computational Growth and Remodeling Simulation. Ruhr-University Bochum, Bochum, Germany.

Oct. 2010 Glaucoma and Computational Multi-Scale Modeling of the Human Eye. *Mechanics and Computation Seminar*, Stanford University, Stanford, California.

Aug. 2010 Computational Multi-Scale Modeling and Remodeling of Biomechanical Structures of the Human Eye. *In Silico Medicine Seminar*, Osaka University, Osaka, Japan.

Oct. 2008 Numerische Mehrskalenmodellierung der Kollagenarchitektur und dessen Umformung im menschlichen Auge (engl. Numerical Multi-Scale Modeling of the Collagen Architecture and its Remodeling in Human Eyes). *Mechanics Colloquium and Seminar*, Technical University of Braunschweig, Braunschweig, Germany.

Sep. 2008 Computational Modeling and remodeling of Human Eye Tissues as Biomechanical Structures at Multiple Scales. *DEI Research Seminar*, Devers Eye Institute, Portland, Oregon.

Refereed Journal Papers

All works are listed in the reversed order of their times of appearance.
*Corresponding author

1. **R. Grytz***, CA Girkin, V. Libertiaux and JC Downs. Perspectives on Biomechanical Growth and Remodeling Mechanisms in Glaucoma. *Mechanics Research Communications*, invited for special issue: “Recent Advances on the Biomechanics of Growth and Remodeling” (in press).

2. **R. Grytz*** and JC. Downs (2011). A Forward Incremental Prestressing Method with Application to Inverse Parameter Estimations from Scleral Inflation Tests. *Computer Methods in Biomechanics and Biomedical Engineering*, DOI:10.1080/10255842.2011.641119.

3. **R. Grytz***, IA. Sigal, JW. Ruberti, G. Meschke and JC. Downs (2012). Lamina Cribrosa Thickening in Early Glaucoma Predicted by a Microstructure Motivated Growth and Remodeling Approach. *Mechanics of Materials*, invited for special issue: “Evolving Microstructures and Anisotropies in Engineering Materials and Biological Tissues”, 44, 99–109.

4. **R. Grytz***, G. Meschke and JB. Jonas (2010). The collagen fibril architecture in the lamina cribrosa and peripapillary sclera predicted by a computational remodeling approach. *Biomechanics and Modeling in Mechanobiology*, 10, pp. 371–382.

5. **R. Grytz*** and G. Meschke (2010). A Computational Remodeling Approach to Predict the Physiological Architecture of the Collagen Fibril Network in Corneo-Scleral Shells. *Biomechanics and Modeling in Mechanobiology*, 9, pp. 225–235.

6. **R. Grytz*** and G. Meschke (2009). Constitutive Modeling of Crimped Collagen Fibrils in Soft Tissues. *Journal of the Mechanical Behavior of Biomedical Materials*, 2, pp. 522–533.

7. **R. Grytz*** and G. Meschke (2008). Consistent micro-macro transitions at large objective strains in curvilinear convective coordinates. *International Journal for Numerical Methods in Engineering* 73, 805–824.

8. Y. Başar and **R. Grytz*** (2004). Incompressibility at Large Strains and Finite-Element Implementation. *Acta Mechanica* 168, 75–101.

Conference Proceedings: Full Papers / Extended Abstracts

9. **R. Grytz**, IA. Sigal, JW. Ruberti, JC. Downs (2011) Microstructure Motivated Growth and Remodeling of the Lamina Cribrosa in Early Glaucoma. In *Proceedings of the ASME 2011 Summer Bioengineering Conference (SBC2011)*, Farmington, Pennsylvania, USA.

10. **R. Grytz** and G. Meschke (2009). Glaucoma and Computational Two-Scale Modeling and Remodeling of the Optic Nerve Head. In *Proceedings of the 7th EUROMECH Solid Mechanics Conference (ESMC2009)*, pp. 313–314, Lisbon, Portugal.

11. **R. Grytz** and G. Meschke (2009). Multiscale Modeling and Computational Remodeling of the Human Eye Tissue. In: K. Gürlebeck and C. Könke (eds.), *Proceedings of the 18th International Conference on the Application of Computer Science and Mathematics in Architecture and Civil Engineering*, Weimar, Germany.

12. **R. Grytz** and G. Meschke (2008). Microstructure-Oriented Modeling and Computational Remodeling of the Collagen Network in Corneo-Scleral Shells. In: J. Eberhardsteiner, C. Hellmich, H. Mang, and J. Périaux (eds.), *Proceedings of ECCOMAS Multidisciplinary Jubilee Symposium 2008*, 14, pp. 155–168, Springer Netherlands.

13. **R. Grytz** and G. Meschke (2008) Computational Remodeling of the Crimped Collagen Fibril Architecture in Corneal and Scleral Tissue. In *Proceedings of the 8th World Congress on Computational Mechanics (WCCM8),* Venice, Italy.

14. **R. Grytz** and G. Meschke (2008). Computational Micro-Macro Transitions at Large Strains for Curvilinear Physical Directions. In *Proceedings in Applied Mathematics and Mechanics* 7, pp. 4080009–4080010.

15. **R. Grytz** and G. Meschke (2006). Computational Homogenization in Multi-Scale Shell Analysis at Large Strains. In *Proceedings of the 3rd European Conference on Computational Mechanics (ECCM 2006)*, Lisbon, Portugal, Springer, doi:10.1007/1-4020-5370-3 592.

Conference Presentations / Abstracts

(presenter underlined if not RG)

1. **R. Grytz**, IA. Sigal, JW. Ruberti, JC. Downs (2011) A Microstructure Motivated Growth and Remodeling Approach to Predict Lamina Cribrosa Thickening in Early Glaucoma. ASME Applied Mechanics and Materials Conference (McMAT 2011), Chicago, Illinois.

2. **R. Grytz**, IA. Sigal, JW. Ruberti, JC. Downs (2011) Lamina Cribrosa Thickening in Early Glaucoma is Predicted by a Biomechanically-Driven Growth and Remodeling Approach. Meeting of the Association for Research in Vision and Ophthalmology (ARVO Abstract 52), Fort Lauderdale, Florida.

3. MA. Fazio, L. Bruno, **R. Grytz**, CA. Girkin, JC. Downs (2011) Analysis of Experimental IOP-induced Scleral Deformations at the Sub-Micrometer Scale Using Electronic Speckle Interferometry. Meeting of the Association for Research in Vision and Ophthalmology (ARVO Abstract 52), Fort Lauderdale, Florida.

4. **R. Grytz**, MJA. Girard, M. Fazio and JC. Downs (2010) Inverse Numerical Estimation of Eye-Specific Intrinsic Material Properties and Local Collagen Architecture from Scleral Inflation Tests. 6th World Congress on Biomechanics (WCB), Singapore.

5. MA. Fazio, **R. Grytz**, MJA. Girard and JC. Downs (2010) Anisotropic, Nonlinear Biomechanical Behavior of Human Posterior Sclera. 6th World Congress on Biomechanics (WCB), Singapore.

6. **R. Grytz**, G. Meschke and JC. Downs (2010) Stress-Based Adaptation and Stretch-Based Optimization Approaches to Estimate the Local Collagen Architecture in Ocular Tissues. 9th World Congress on computational Mechanics (WCCM), Sydney, Australia.

7. **R. Grytz**, MJA. Girard, M. Fazio, CF. Burgoyne and J.C. Downs (2010) Biomechanical Implications of Age-related Alterations in Scleral Collagen Fibril Crimp. Meeting of the Association for Research in Vision and Ophthalmology (ARVO Abstract 51), Fort Lauderdale, Florida.

8. **R. Grytz**, G. Meschke and Jost B. Jonas (2009) A Mathematical Approach to Predict the Local Microarchitecture of the Lamina Cribrosa (LC) and Peripapillary Sclera (PPS). Meeting of the Association for Research in Vision and Ophthalmology (ARVO Abstract 50), Fort Lauderdale, Florida.

9. **R. Grytz** and G. Meschke (2009) Glaucoma and Numerical Modeling and Remodeling of the Lamina Cribrosa at Multiple Scales. X International Conference on Computational Plasticity (COMPLAS), Barcelona, Spain.

10. **R. Grytz** and G. Meschke (2009) Computational modeling and remodeling of the collagen architecture in human eye tissues. 80th Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM 2009), Gdańsk, Poland.

11. **R. Grytz**, S. Jox, F. Nagel, G. Meschke (2008). Microstructure-oriented multi-phase characterization of biological and engineering materials and structures. ECCOMAS Multidisciplinary Jubilee Symposium, Vienna, Austria.

12. **R. Grytz** and G. Meschke (2007) An incompressible finite shell element with crimped collagen fibers for numerical analyses of the human eye. Modeling of Heterogeneous Material with Application in Construction and Biomedical Engineering, Prague, Czech Republic.

13. **R. Grytz** and G. Meschke (2007) Computational Micro-Macro Transitions at Large Strains for Curvilinear Physical Directions. 6th International Congress on Industrial and Applied Mathematics (ICIAM07), Zurich, Switzerland.

14. **R. Grytz** and G. Meschke (2007) Computational Micro-Macro Transitions at Large Strains for Curvilinear Physical Directions. 2nd GACM Colloquium on Computational Mechanics, Munich, Germany.

15. **R. Grytz** and G. Meschke (2005) Computational Homogenization Analysis at Large Strains in Curvilinear Convective. 1st GACM Colloquium on Computational Mechanics, Bochum, Germany.

Consulting Report

1. G. Meschke, **R. Grytz** and M. Gofmann (2005). Grundlagen der statischen Berechnung und Bemessung von Sandwich-Linern für die Sanierung geschädigter Abwasserschächte (engl. Computational Sizing of Sandwich Liners to Stabilize Damaged Sewage Hoppers), by order of the Institute for Underground Infrastructure, Bochum, Germany.

Master Thesis Supervision

1. Con Nguyen, Das Auge als biomechanische Struktur: Finite-Elemente Modellierung (engl. The Human Eye as Biomechanical Structure: Finite-Element Modeling), 2007.

2. Philippe Jäger, Parallelisierung von Mehrskalen-Analysen im Rahmen der nichtlinearen Finite-Elemente-Methode (engl. Parallelization of Multi-Scale Finite Element Analyses), 2005.

3. Christine Teck, Minimalflächen **–** Formfindung und Optimierung von Membranen (engl. Minimal Surfaces– Form Finding and Optimization of Membranes), 2004.

Teaching Experience

Civil Engineering and Computational Engineering, Ruhr-University Bochum

	Class	Semester
1.	Teaching Assistant, Matritzenmethoden der Stabstatik (engl. Computational methods in Structural Mechanics of Beams)	SS 2003 SS 2004 SS 2005 SS 2006 SS 2007 SS 2008
2.	Teaching Assistant, Baustatik III (engl. Adv. Structural Mechanics)	WS 2003/04 WS 2004/05 WS 2005/06 WS 2006/07 WS 2007/08 WS 2008/09
3.	School Project Coordinator, Von Windkanälen, Brücken und Häusern (engl. About Wind Tunnels, Bridges and Buildings), School Project at the “Alfried Krupp Schülerlabor“	throughout 2003 – 2009