Pim J.A. **Oomen**, Ph.D.

Senior Scientist · Cardiovascular Medicine · University of Virginia

pim@virginia.edu | PimOomen | publications

Education

TU Eindhoven (Eindhoven University of Technology) — *Eindhoven, Netherlands (NLs)*

Ph.D. in Biomedical Engineering — *Apr 2018*

- Visiting student researcher at Stanford University, Department of Mechanical Engineering

TU Eindhoven — *Eindhoven, NLs*

M.S. in Biomedical Engineering — *Mar 2014*

- Research student at University of Texas at Austin, Center for Cardiovascular Modeling & Simulation and Department of Biomedical Engineering
- Industry internship at Royal DSM and Royal London Hospital

TU Eindhoven — *Eindhoven, NLs*

B.S. in Biomedical Engineering — *Jun 2011*

- Erasmus Study Abroad student at Queen Mary, University of London, Fall 2010

Research objective

Developing multiscale computational and experimental approaches to investigate the mechanics of growth and remodeling in cardiovascular tissues and to harness these processes to improve and design medical devices and therapies.

Research experience

Postdoctoral Research Associate — *University of Virginia*

PIs: Jeffrey Holmes, Ph.D. M.D. & Kenneth Bilchick, M.D. — *May 2018 - Present*

- Goal: develop computational models to predict and optimize cardiac remodeling following cardiac resynchronization therapy (CRT).
- Developed fast electro-mechanical model of reverse cardiac remodeling following CRT and validated it to experimental data.
- Collaborating with cardiologists to collect patient data to extend the model to predict long-term patient-specific CRT outcomes.
- Collaborating with industry and cardiologists to devise and test a new method for fusing multiple clinical imaging modalities (MRI, CT, and fluoroscopy) to guide surgeon strategy during device implantation surgery.

Ph.D. Candidate — *TU Eindhoven*

PIs: Carlijn Bouten, Ph.D., Sandra Loerakker, Ph.D. & Frank Baaijens, Ph.D. — *May 2014 - April 2018*

- Goal: identifying the mechanical factors that dictate growth and remodeling in native and tissue-engineered heart valves.
- Collaborated with the Dutch Heart Valve Bank to compile a comprehensive data set of human native heart valves ranging from fetal to adult origin.
- Applied numerical and experimental techniques to characterize human native heart valves and identify the driving forces of collagen remodeling in aortic and pulmonary heart valves.
- Developed a novel bioreactor with an integrated nondestructive mechanical testing method to systematically unravel the mechanics of growth and remodeling in engineered cardiovascular tissues.

Ph.D. Research Student — *Stanford University*

PI: Ellen Kuhl, Ph.D. — *Apr 2016 - Sep 2017*

- Created a finite element model of growth and remodeling of human native heart valves to investigate the specific contributions of growth and remodeling during the postnatal development of human aortic and pulmonary heart valves.

M.S. Research Student — *University of Texas at Austin*

PI: Michael Sacks, Ph.D. — *Apr 2012 - Aug 2012*

- Anatomically, structurally, and mechanically characterized porcine mitral valves and subsequently generation of a high-fidelity finite element model for simulations of functional mitral valve repair.
- Collaborated with a cardiac surgeon to learn how to perform surgical mitral valve repair.

M.S. Student Intern *Royal DSM & Royal London Hospital*

PIs: Eric Becker, Ph.D., Nicola Mafuli, M.D. *Sep 2011 - Apr 2012*

- Collaborated with industry and an orthopedic surgeon to performed systemic literature studies to investigate the potential of Ultra-high-molecular-weight polyethylene (Dyneema) as a novel material for olecranon and patella fracture fixation.

B.S. Research Student *TU Eindhoven*

PI: Cees Oomens, Ph.D. *Jan 2011 - Jun 2011*

- Experimentally investigated the relation between microstructural and macromechanical properties of electrospun polycaprolactone scaffolds for tissue engineering.

Grants & Fellowships

2021– **R01 Research Grant: "Multiscale Models for Predicting Short and Long-term Outcome of Cardiac Resynchronization Therapy"**, NIH NIBIB

2016 **Fellowship**, Cardiovascular Research Netherlands & Dutch Heart Foundation Young Talent Award, to perform heart valve-related research at Stanford University

2012 **Scholarship**, TU Eindhoven Fund International Experience, for performing research at University of Texas at Austin

2010 **Scholarship**, Erasmus grant for studying one semester abroad in London, United Kingdom

Honors & Awards

2021 **Honor**, Named Rising Star in Engineering in Health by Columbia University

2018 **Travel award**, European Society of Biomechanics

2017 **Award**, Winner of the annual European Society of Biomechanics Student Award

2017 **Travel award**, Euromech supporting grant for early-stage researchers

2014 **Award**, Winner of the annual poster prize of Materials Technology Institute Eindhoven

Publications

1. **Oomen PJA**, Phung TKN, Bilchick KC, Holmes JW. A rapid electro-mechanical model to predict reverse remodeling following cardiac resynchronisation therapy. Biomechanics and Modeling in Mechanobiology, 2021. https://doi.org/10.1007/s10237-021-01532-7

2. Gao X, Abdi M, Auger DA, Sun C, Hanson C, Robinson A, Schumann C, **Oomen PJA**, Ratcliffe S, Malhotra R, Darby A, Monfredi OJ, Mangrum JM, Mason P, Mazimba S, Holmes JW, Kramer CM, Epstein FH, Salerno M, Bilchick KC, Cardiac Magnetic Resonance Assessment of Response to Cardiac Resynchronization Therapy and Programming Strategies. JACC: Cardiovascular Imaging, 2021. https://doi.org/10.1016/j.jcmg.2021.06.015

3. **Oomen PJA**, Holland MA, Bouten CVC, Kuhl E, Loerakker S. Mechanical models suggest that growth and remodeling play opposing roles during the development of human heart valves. *Scientific Reports*, 8(1235), 2018. https://doi.org/10.1038/s41598-018-19777-1

4. Van Kelle MAJ*, **Oomen PJA***, Janssen-van den Broek MWJT, Lopata RGP, Loerakker S, Bouten CVC. Initial scaffold thickness affects the emergence of a geometrical and mechanical equilibrium in engineered cardiovascular tissues. *Journal of the Royal Society Interface*, 115(148), 2018. https://doi.org/10.1098/rsif.2018.0359

5. **Oomen PJA**, van Kelle MAJ, Oomens CWJ, Bouten CVC, Loerakker S. Nondestructive mechanical characterization of developing biological tissues using inflation testing. *Journal of the Mechanical Behavior of Biomedical Materials*, 74:438-447, 2017. https://doi.org/10.1016/j.jmbbm.2017.07.009

6. Van Kelle MAJ*, **Oomen PJA***, Bulsink JA, Janssen-van den Broek MWJT, Lopata RGP, Rutten MCM, Loerakker S,Bouten CVC. A bioreactor to identify the driving Mechanical stimuli of tissue growth and remodeling. *Tissue*

Engineering: Part C, 23(6):377-87, 2017. https://doi.org/10.1089/ten.TEC.2017.0141

7. **Oomen PJA**, Loerakker S, van Geemen D, Neggers J, Goumans MJTH, van den Bogaerdt AJ, Bogers AJJC, Bouten CVC, Baaijens FPT. Age-dependent changes of stress and strain in the human heart valve and their relation with collagen remodeling. https://doi.org/10.1016/j.actbio.2015.10.044.
8. Van Geemen D, Soares ALF, **Oomen PJA**, Driessen-Mol A, Janssen-van den Broek MWJT, van den Bogaerdt AJ, Bogers AJJC, Goumans MJTH, Baaijens FPT, Bouten CVC. Age-dependent changes in geometry, tissue composition and mechanical properties of fetal to adult cryopreserved human heart valves. *PLoS One*, 11(2), 2016. https://doi.org/10.1371/journal.pone.0149020
9. den Hamer A, Heusinkveld MHG, Traa WA, **Oomen PJA**, Oliva F, Del Buono A, Mafulli N. Current techniques for management of transverse displaced olecranon fractures. *Muscles, Ligaments and Tendons Journal*, 5(2):129–140, 2015. https://doi.org/10.11138/mltj/2015.5.2.129
10. Lee CH, **Oomen PJA**, Rabbah JP, Yoganathan A, Gorman RC, Gorman III JH, Amini R, Sacks MS. A high- fidelity and micro-anatomically accurate 3D finite element model for simulations of functional mitral valve. *Functional Imaging and Modeling of the Heart, Lecture Notes in Computer Science*, 7945:16-24, 2013. https://doi.org/10.1007/978-3-642-38899-6_49
11. Traa WA*, **Oomen PJA***, den Hamer A, Heusinkveld MH, Maffulli N. Biomechanical studies on transverse olecranon and patellar fractures: a systematic review with the development of a new scoring method. *British Medical Bulletin*, 108:131-157, 2013. https://doi.org/10.1093/bmb/ldt020
12. Heusinkveld MHG, den Hamer A, Traa WA, **Oomen PJA**, Maffulli N, Treatment of transverse patellar fractures: A comparison between metallic and non-metallic implants. *British Medical Bulletin*, 107:69–85, 2013. https://doi.org/10.1093/bmb/ldt013

* Co-first author

Conference Presentations

1. “Personalized Virtual Cardiac Resynchronization Therapy To Predict And Optimize Long-Term Remodeling Outcome – A Case Study”, 2021 U.S. National Congress on Computational Mechanics, Online (Virtual presentation).
2. “Integration of MRI and fluoroscopy to determine optimal CRT pacing sites and quadripolar pacing vectors”, 2020 Heart Rhythm Scientific Sessions, Online (Virtual poster).
3. “Personalized Virtual Cardiac Resynchronization Therapy Simulation based on a 12-lead ECG and CMR predicts electrical activation changes after cardiac resynchronization therapy”, 2020 American Heart Association Scientific Sessions, Online (Virtual presentation).
4. “Predicting the outcome of cardiac resynchronization therapy using a fast electro-mechanical model”, 2020 Summer Biomechanics, Bioengineering and Biotransport Conference, Online (Virtual presentation).
5. “Multiscale Models of Cardiac Growth, Remodeling, and Myocardial Infarction”, 2019 Multiscale Modeling Consortium Meeting - Translation and Dissemination, National Institute of Health, Bethesda, MD (Poster).
6. “Fast predictions of cardiac growth during ventricular dyssynchrony”, 2019 Summer Biomechanics, Bioengineering and Biotransport Conference, Seven Spring, PA (Podium presentation).
7. “Emergence of a geometrical and mechanical equilibrium in engineered cardiovascular tissues”, 2018 World Conference of Biomechanics, Dublin, Ireland (Podium presentation).

8. “The interplay of growth and remodeling in human heart valves during somatic growth”, 2017 European Society of Biomechanics Conference, Sevilla, Spain (Plenary presentation, award lecture).
9. “Predicting age-dependent changes in human heart valves due to growth”, 2017 Euromech colloquium: advanced experimental methods in tissue biomechanics, Warberg, Germany (Podium presentation).
10. “Predicting age-dependent changes in human native heart valves due to growth and remodeling”, 2017 International Conference on Computational Methods for Coupled Problems in Science and Engineering, Rhodes, Greece (Invited presentation).
11. “Real-time monitoring of the mechanical properties of engineered tissues during growth and remodeling”, 2016 Summer Biomechanics, Bioengineering and Biotransport Conference, National Harbour, MD (Podium presentation).
12. “Age-dependent changes in stress and strain in the human native heart valve and their relation with collagen remodeling”, 2015 Summer Biomechanics, Bioengineering and Biotransport Conference, Snowbird, UT (Podium presentation).
13. “Causes and consequences of collagen architecture remodeling in human native heart valves”, 2014 Computational Methods in Biomechanics and Biomedical Engineering, Amsterdam, NLs (Podium presentation).

Teaching

Co-instructor — *University of Virginia*

Integrative Design & Experimental Analysis Lab: Biomechanics of Soft Tissues module — *Spring 2020 - Present*

- Course aimed at integrating concepts and theory from current lectures and prior courses in an hands-on laboratory environment.
- Teaching lectures and running labs for the Biomechanics module in Fall 2020 for 128 third-year biomedical engineering students.
- Mentored lab groups in the Spring 2020 semester, where each student completed a unique capstone project in the subject area of their choice – for example one student group designed a tissue-engineered replacement of cartilage.

Guest lecturer — *University of Virginia*

Biomechanics — *Fall 2019*

- Title: Mechanical testing: the challenges (and importance) of testing real biological materials.

Guest lecturer — *University of Notre Dame*

Introduction to Biomechanics — *Spring 2019*

- Title: Biomechanical Models of the Heart for Clinical Decision-making.

Guest lecturer — *International Center for Mechanical Sciences (CISM, Udine, Italy)*

Material Parameter Identification and Inverse Problems in Soft Tissue Biomechanics — *Spring 2017*

- Title: Estimating the mechanical properties of growing tissues.

Teaching Assistent — *TU Eindhoven*

Numerical Analysis of Continue II — *Fall 2016*

- Graduate course on nonlinear continuum mechanics and the finite element method.
- Held office hours on deriving mathematical principles behind the finite element method.
- Guided hands-on component of the course: using finite element software package (Abaqus) to model biomedical problems.

Project mentor *TU Eindhoven*

DESIGN-BASED LEARNING PROJECTS *Sep 2012 - Jun 2015*

- Design-based learning projects aimed to offer students the opportunity to gain experience of issues in the field and how to work together in a multidisciplinary team.
- In each semester throughout their undergraduate curriculum, students work in a changing group of 4-8 students to design innovative solutions to address a relevant biomedical problem.
- As a mentor, I guided semi-weekly group meetings and supported students in designing and penrforming their own experiments and models and writing of final reports.
- Project topics: soft tissue biomechanics, mechanical testing, tissue engineering, systems biology.

Mentoring

Graduate students

2019-Present	**Vignesh Valaboju**, Computational modeling of baroreceptor reflexes.	*University of Virginia*
2017-2018	**Leon Hermans**, Tissue-engineering of anisotropic tissues.	*TU Eindhoven*
2017-2018	**Wouter Hameeteman**, Developing a constrained-mixture model for heart valve growth.	*TU Eindhoven*
2015-2016	**Guus de Leeuw**, Optimizing cryopreservation of heart valve allografts.	*TU Eindhoven*

Undergraduate students

2020-Present	**Nabeel Raza**, Modeling electrical propagation in ventricular dyssynchrony.	*University of Virginia*
2020-Present	**Matthew Lim**, Modeling hypertrophic cell signaling and myocardial remodeling.	*University of Virginia*
2020-Present	**Nicole Attram**, Exploring moderately increased heart rate as heart failure therapy.	*University of Maryland Baltimore County (REU)*
2020-Present	**Radhika Pande**, Quantifying cardiomyocyte growth in dyssynchronous hearts.	*University of Virginia*
2020	**Shipra Trivedi**, Quantifying cardiomyocyte growth in dyssynchronous hearts.	*University of Virginia*
2020	**Karen Carter**, Histology and MRI analysis of remodeling of dyssynchronous hearts.	*University of Alabama at Birmingham (REU)*
2018-2019	**Vignesh Valaboju**, Computational exploration of cardiac remodeling growth stimuli.	*University of Virginia*
2018-2019	**Megan Thomas**, Capstone, Designing a UI to integrate a predictive model in the clinic.	*University of Virginia*
2018-2019	**Christian Devlin**, Capstone, Designing a UI to integrate a predictive model in the clinic.	*University of Virginia*
2017	**Jeroen Verberne**, Optimization of tissue-engineered heart valve geometry.	*TU Eindhoven*
2017	**Lissa Verhoeven**, Nondestructive mechanical testing of engineered tissues.	*TU Eindhoven*
2017	**Jolijn Lubrecht**, Measuring and modeling tissue-engineered heart valve geometry.	*TU Eindhoven*
2016-2017	**Luuk van den Bogaert**, Measuring tissue-engineered heart valve geometry using Ultrasound.	*TU Eindhoven*
2016	**Yeshi de Bruijn**, Measuring the thickness of engineered tissues using ultrasound.	*TU Eindhoven*
2016	**Guusje Evers**, Exploring the influence of culture time and loading conditions on engineered tissues.	*TU Eindhoven*

Leadership

UVA Postdoctoral Association — *Charlottesville, VA*

Founding Board Member — *Nov 2018 - Present*

- Co-founder of the UVA Postdoctoral Association and leader of two committees.
- Community building: created a thriving community of postdocs across all departments by organizing social activities.
- Diversity and outreach: organized events on racism in science, and mentoring opportunities for underrepresented minorities for K-12 students in the greater Charlottesville area.

University outreach — *Charlottesville, VA & Eindhoven, NLs*

Representative — *Sep 2009 - Present*

- Mentoring US high school students for Biology research projects.
- Consulting Dutch high school student on degree choice.
- Giving guest classes at Dutch middle and high schools
- Hosted open-house days for prospective students, and science and industry fairs).

Biomedical Engineering Student Symposium — *Eindhoven, NLs*

Scientific Chair — *Sep 2012 - May 2013*

- Developed scientific program of the annual Biomedical Engineering student symposium “Regenerative Medicine: Engineering the Unimaginable” that would appeal to students of all levels and backgrounds.
- Recruited international speakers from academia and industry.

Biomedical Engineering Study tour *South Korea & Eindhoven, NLs*

CHAIRMAN *Jun 2012 - May 2013*

- Organized a three-week study tour of 30 Biomedical Engineering students and 3 faculty members to South Korea.
- Activities included: organizing academic visits, industry visits, and cultural activities in Korea, recruiting sponsors, and acquiring funding by setting up research projects with Dutch industry (including Philips Healthcare and Royal DSM).

Service

2020-Present **Reviewer**, Biomechanics and Modeling in Mechanobiology
2019 - Present **Committee member**, ASME Bioengineering Division Solids Technical Committee
2019 - Present **Abstract reviewer**, Summer Biomechanics, Bioengineering, and Biotransport Conference
2019-Present **Reviewer**, Journal of the Mechanical Behavior of Biomedical Materials
2018-Present **Reviewer**, Journal of Biomechanics
2017 **Session moderator**, European Society of Biomechanics Conference

Professional Memberships
American Heart Association
Biomedical Engineering Society
European Society of Biomechanics

Technical skills

Modeling	Finite element analysis, inverse analysis, constitutive modeling, network models
Experimental	Mechanical testing, Histology, Confocal microscopy, Biochemical Analysis, Bioreactor Development
Clinical	Ultrasound imaging, Magnetic Resonance Imaging, Fluoroscopy, Pacemaker optimization
Software & Programming	Matlab, Abaqus, Python, Latex, Git, HTML, PHP, JavaScript, SQL
Languages	Dutch (native), English (fluent), German (proficient), French (intermediate)