CURRICULUM VITAE

Michael Geoffrey Bateman
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PROFESSIONAL INFORMATION

Current Academic Appointment:

Assistant Professor, University of Minnesota, Department of Surgery, MN, USA **2017-present**
Dean: Jakub Tolar, MD, PhD

Current Research Interests:

My research interests revolve around the use of Visible Heart® methodologies for the development of novel instrumentation and biomedical devices for physiological monitoring, clinical evaluation and/or therapeutic use. I have the following research interests:

1. The use of Visible Heart® methodologies to forward the design and development of structural heart disease therapies such as coronary stenting, septal closure devices, transcatheter delivered valves and novel percutaneous devices to treat structural heart defects.
2. Cardiac anatomy and physiology based on patient demographic and disease morphologies and how such variability affects the design and development of percutaneous cardiac therapies.
3. The integration of clinical, ex vivo, and in vitro imaging into the understanding of the functional anatomy of the heart with respect to cardiac device development.
4. The use of plastination, 3D imaging, additive manufacturing and virtual reality as tools for medical device development and as educational tools at all levels of prior knowledge competency.

Education:

Degree	Institution	Date Degree Granted
B.Eng.	University of Bristol, Bristol, UK (Junior Year Abroad: Rice University, TX, USA, 2002-03)	2003
M.Eng.	University of Bristol, Bristol, UK Advisor: Martyn Pavier MA, PhD, MIMechE, CEng Thesis: "Measurement of Residual Stresses in Carbon Fibre using the Deep Hole Drilling Technique"	2004
PhD	University of Minnesota, MN, USA Advisor: Paul A. Iaizzo, PhD Thesis: "Investigations into the Effects if Transcatheter Valve Implantations on the Cardiac Conduction System and Cardiac Anatomy"	2012

Industry Experience:

Title	Organization	
Senior Scientist	Medtronic, Inc., Mounds View, MN	2012-2017

Responsibilities: Worked on the Anatomic and Device Characterization Team for Medtronic's Coronary & Structural Heart Research and Innovation division. My responsibilities included:

- Acted as the subject matter expert for aortic valve anatomy and aortic valve disease morphology.
- Led a team to complete the post-implant in-vivo characterization of market released transcatheter aortic valve to inform on the long-term clinical performance of the device and understand the in-vivo loading conditions throughout the cardiac cycle.
- Led a small Innovation and Design team to investigate a novel structural and electrophysiological combination therapy for aortic valve disease patients.
- Modelled and analyzed the relevant anatomy from MR, CT and Echocardiographic imaging of cardiac valve disease patients to inform on test conduit manufacture, benchtop testing boundary conditions, FEA and CFD simulation models and anatomical variations within patient populations for device development.
- Coordinated with physicians and key opinion leaders to develop novel patient screening methodologies to improve procedural outcomes and assisted in the development of novel inter-procedural imaging techniques.
- Supported Corrective and Preventative Action teams through anatomical anatomical and post implant device characterization to help resolve adverse field events.

Scientist Intern	Medtronic, Inc., Mounds View, MN	2011-12

Responsibilities: Worked as an intern in the Structural Heart Research and Innovation division supporting an investigation into the use of CT imaging for CoreValve sizing and patient selection. My responsibilities included the management of patient imaging datasets and the analysis and reporting of patient anatomical data relevant to the CoreValve sizing project.

Design Engineer	CG Verastile Fittings (Now ItabUK), Hemel Hempstead, UK	2005-06

Responsibilities: Worked as a product design engineer supporting projects for the company's lead customer from conception through drafting to manufacture. It was my responsibility to ensure that the project proceeded in an expedient and cost-effective manner.

Current Membership and Offices in Professional Organizations

American Society of Mechanical Engineers (ASME)	2018-present
Institute for Electrical and Electronics Engineers (IEEE)	2018-present
Heart Rhythm Society (HRS)	2018-present
Biomedical Engineering Society (BMES)	2008-present
American Heart Association (AHA)	2008-present
American Association of Anatomists (AAA)	2008-present
Institute for Mechanical Engineers (IMechE)	2000-2006

RESEARCH AND SCHOLARSHIP

Grants and Contracts

EXTERNAL SOURCES

Pending

"Development and validation of an advanced laparoscopic surgical simulator" GRANT12563460; Co-PI: James Harmon MD; $400,000 direct costs (10% effort)

PUBLICATIONS

Peer-Reviewed Publications

1. **Bateman MG,** Durfee WK, Iles TL, Martin CM, Liao K, Erdman AG, Iaizzo PA, Patient-specific 3D models as surgical planning tools. In Press *SURGERY: Innovation Series*, 2018.

2. Zhingre Sanchez JD, **Bateman MG**, Iaizzo PA, Multimodal imaging of CoreValve Evolut™ R transcatheter aortic valve replacement (TAVR) in a reanimated human heart and subsequent 3D modeling and printing of te deployed valve. Submitted to *JACC: Cardiovascular Imaging*, 2018.

3. Holda MK, Zhingre Sanchez JD, **Bateman MG**, Iaizzo PA, Right atrioventricular valve morphology redefined - implications for transcatheter repair procedures. In Press *JACC: Cardiovascular Interventions*, 2018.

4. Stephenson RS, Atkinson A, Kottas P, Perde F, Jafarzadeh F, **Bateman MG**, Iaizzo PA, Zhao J, Zhang H, Anderson RH, Jarvis JC, Dobrzynski H, High resolution 3-dimensional imaging of the human cardiac conduction system from microanatomy to mathematical modeling. *Scientific Reports*, 7:7188 (2017).

5. Atkinson AJ, Kharche SR, **Bateman MG**, Iaizzo PA, Dobrzynski H, 3D anatomical reconstruction of human cardiac conduction system and simulation of bundle branch block after TAVI procedure. *2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society,* (2016), pp, 5583-5586.

6. Spencer JH, Quill JL, **Bateman MG**, Eggen MD, Howard SA, Goff RP, Howard BT, Quallich SG, Iaizzo PA, The benefits of the Atlas of Human Cardiac Anatomy website for the design of cardiac devices. *Expert Rev Med Devices*, 10 (2013) (6), pp, 729-34.

7. Howard SA, **Bateman MG**, Hill AJ, Anderson RH, Iaizzo PA, In vitro images of a double orifice mitral valve in a reanimated heart. *Ann Thorac Surg,* 95 (2013) (4), pp, 1456.

8. **Bateman MG**, Hill AJ, Quill JL, Iaizzo PA, The clinical anatomy and pathology of the human arterial valves: implications for repair or replacement. *J Cardiovas Transl Res,* 6 (2013) (2), pp, 166-75.

9. **Bateman MG**, Quill JL, Hill AJ, Iaizzo PA, The clinical anatomy and pathology of the human atrio-ventricular valves: implications for repair or replacement. *J Cardiovas Transl Res,* 6 (2013) (2), pp, 155-65.

10. **Bateman MG**, Iaizzo PA, Imaging in the context of replacement heart valve development: the use of the Visible Heart® methodologies. *Cardiovasc Diagn Ther,* 2 (2012) (3), pp, 220-230.

11. Tsang W, **Bateman MG**, Weinert L, Pellegrini G, Mor-Avi V, Sugeng L, Yeung H, Patel AR, Hill AJ, Iaizzo PA Lang RM, Accuracy of aortic annular measurements obtained from three-dimensional Echocardiography, CT and MRI: human in vitro and in vivo studies. *Heart,* 98 (2012) (15), pp, 1146-1152.

12. **Bateman MG**, Iaizzo PA, Comparative imaging of cardiac structures and function for the optimization of transcatheter approaches for valvular and structural heart disease. *International Journal of Cardiovascular Imaging,* 27 (2011) (8), pp, 1223-1234.

13. Brusen RM, Rolfes C, Howard S, **Bateman MG**, Iaizzo PA, A device and methodology for continuous hypothermic perfusion of explanted large mammalian hearts, followed by in-vitro Langendorff reanimation: Pilot studies. *Journal of Medical Devices* 4(2):027530, 2011.

14. Quill JL, **Bateman MG**, St. Louis JL, Iaizzo PA, Edge-to-edge repair of isolated swine hearts with P2 prolapse, *Journal of Heart Valve Disease,* 20 (2010) (1), pp, 5-12.

15. Eggen MD, **Bateman MG**, Rolfes CD, Howard SA, Swingen CM and Iaizzo PA, MRI assessment of pacing induced ventricular dyssynchrony in an isolated human heart. *Journal of Magnetic Resonance Imaging,* 32 (2010) (2), pp, 466-469.

16. **Bateman MG**, Miller OH, Palmer TJ, Breen CEP, Kingston EJ, Smith DJ and Pavier MJ, Measurement of residual stress in thick section composite laminates using the deep-hole method, *Int J Mech Sci,* **47** (2005) (11), pp. 1718–1739.

Media Presentations or Interviews

1. "Visible Heart Laboratory" April 30th 2010, Minnesota Daily, University of Minnesota, MN https://www.youtube.com/watch?v=VS22U4S8G1c

Book Chapters

1. **Bateman MG**, Iles TL, Iaizzo PA, Advancing the Design and Testing of Novel Cardiac Device Technologies Using the Visible Heart®. In: Iaizzo PA, editor. Engineering in Medicine: Advances and Opportunities, Elsevier, 2018, *In Press*.
2. **Bateman MG**, Quill JL, Hill AJ, Iaizzo PA, Detailed Anatomical and Functional Features of the Cardiac Valves. In: Iaizzo PA, editor. The Handbook of Cardiac Anatomy, Physiology and Devices, Springer, 2015, 3rd edition, pp 115-136
3. **Bateman MG**, Eggen MD, Spencer JH, Iles TL, Iaizzo PA, The Use of Isolated Heart Models and Anatomic Specimens as Means to Enhance the Design and Testing of Cardiac Devices. In: Iaizzo PA, editor. The Handbook of Cardiac Anatomy, Physiology and Devices, Springer, 2015, 3rd edition, pp 751-764.
4. Howard SA, **Bateman MG**, Laske TG, Iaizzo PA, Current Status of Development and Regulatory Approval of Cardiac Devices. In: Iaizzo PA, editor. The Handbook of Cardiac Anatomy, Physiology and Devices, Springer, 2015, 3rd edition, pp 765-776.

5. **Bateman MG**, Quill JL, Hill AJ, Iaizzo PA, The Anatomy and Function of the Atrio-ventricular Valves. In: Iaizzo PA, editor. Heart Valves: From Design to Clinical Implantation, 1st edition. Springer, 2012, pp 3-25.

6. **Bateman MG**, Quill JL, Hill AJ, Iaizzo PA, The Anatomy and Function of the Semi-lunar Valves. In: Iaizzo PA, editor. Heart Valves: From Design to Clinical Implantation, 1st edition. Springer, 2012, pp, 27-43.

7. **Bateman MG**, Hill AJ, Quill JL, Eggen MD, Rolfes CD, Iaizzo PA, The Use of Isolated Heart Models and Anatomic Specimens as Means to Enhance the Designs and Testing of Cardiac Valve Therapies. In: Iaizzo PA, editor. Heart Valves: From Design to Clinical Implantation, 1st edition. Springer, 2012, pp 359-380.

8. Ahlberg SE, **Bateman MG**, Eggen MD, Quill JL, Richardson ES, Iaizzo PA, Animal Models for Cardiac Valve Research. In: Iaizzo PA, editor. Heart Valves: From Design to Clinical Implantation, 1st edition. Springer, 2012, pp 343-358.

9. Howard SA, **Bateman MG**, Laske TG, Iaizzo PA, Successful Development and Regulatory Approval of Replacement Cardiac Valves. In: Iaizzo PA, editor. Heart Valves: From Design to Clinical Implantation, 1st edition. Springer, 2012, pp 381-402.

10. **Bateman MG**, Howard SA, Rolfes CD, Laske TG, Iaizzo PA, Cardiac Devices and Testing. In: Hoffman K-P, editor. Handbook of Medical Technology, 1st edition. Springer, 2012, Part D, pp, 855-876.

Patents

US Patent Applications

1. **US20170258586A1** "Stented prosthetic heart valve having a wrap and delivery devices": **Bateman MG**, Clague C, Sandstrom J, Racchini J, Keogh JR: Filed September 14th 2017

WIPO Patent Applications

1. **WO2018093565A1** "Stabilization and advancement system for direct aortic transcatheter aortic valve implantation": Traci Jones, Lars Mattison, Jasper Adamek-Bowers, Paul Willliam Jr., Paul Iaizzo, Angela Duffy, **Michael Bateman**, Nathan Starkson, Aditya Newalkar: Filed May 24th 2018
2. **WO2018136153A1** "Transcatheter delivery systems and delivery catheters for prosthetic mitral valve delivery, and methods for prosthetic mitral valve delivery using a retrograde approach": Barry O'connell, Patrick Griffin, **Michael Bateman**, William Haynes: Filed 26th August 2018

Websites

1. www.vhlab.umn.edu
2. www.vhlab.umn.edu/atlas

Presentations

Invited Oral Presentations at International Professional Meetings, Conferences, etc.

1. **Bateman MG**. "An Overview of Cardiac Research at the Visible Heart® Laboratory." Guest lecture: *Cardiovascular Research Group*, University of Manchester, UK, May 2009

Invited Oral Presentations at National Professional Meetings, Conferences, etc.

1. **Bateman MG**. "CardioVascular Modelling and Design." Invited lecture: *North Carolina State University Fitts Industrial and Systems Engineering Advanced Manufacturing & Logistics Fall Symposium, Durham, NC.* 17th October 2013.

2. **Bateman MG**. "Fostering Strong Collaborations between Academia and Industry." Guest lecture: *Decrease Time to Market through Academic Collaborations, Materialise Workshop, BMES 2011, Hartford, CT.* 15th October 2011.

3. **Bateman MG**. "An Extensive Knowledge of both Cardiac Anatomy and Electrophysiology is Required for Cardiac Device Development." Guest lecture: *R&D Department, Medtronic Heart Valves, Santa Ana, CA.* 28th April 2010.

Invited Oral Presentations at Local and Regional Professional Meetings, Conferences, etc.

1. **Bateman MG**, Spencer JH. "Cardiac Anatomy Modeling and Atlas Website Tutorial" Guest Lecture: *"Advanced Cardiac Physiology & Anatomy Course, University of Minnesota, MN.* 12th January 2018.

2. **Bateman MG**, Quill JL. "Valve Anatomy and Transcatheter Valves/Minimally Invasive Valve Repair Procedures" Guest Lecture: *"Advanced Cardiac Physiology & Anatomy Course, University of Minnesota, MN.* 10th January 2018.

3. **Bateman MG**, Hutchens J. "Mechanical Aspects of Cardiac Performance: Blood Pressure, Heart Tones, and Diagnoses" Guest Lecture: *"Advanced Cardiac Physiology & Anatomy Course, University of Minnesota, MN.* 10th January 2017.

4. **Bateman MG,** Falk W, Ciobanu C, Mearns P. "Defining the Boundary Conditions for Delivery System Benchtop Testing Through Analysis of the Patient Anatomy." Invited lecture: *Science and Technology Conference 2016, Medtronic, Inc. Minneapolis, MN.* 26th October 2016.

5. **Bateman MG**. "Cardiac Valve Therapy Development in the Transcatheter Age." Session Chair: *Design of Medical Devices Conference 2016, Minneapolis, MN.* 12th April 2016.

6. **Bateman MG**, Spencer JH. "Cardiac Anatomy Modeling and Atlas Website Tutorial" Guest Lecture: *"Advanced Cardiac Physiology & Anatomy Course, University of Minnesota, MN.* 8th January 2016.

7. **Bateman MG,** Wang W, Secord T, Ha D, Menk A, Roller S. "Design of Experiments Study to Determine the Main Factors Effecting ParaValvular Leak in the current Silicone Test Conduit." Invited lecture: *Science and Technology Conference 2015, Medtronic, Inc. Minneapolis, MN.* 28th October 2015.

8. **Bateman MG**, Skadsberg ND. "3D Electrophysiologic Cardiac Mapping" Guest Lecture: *"Advanced Cardiac Physiology & Anatomy Course, University of Minnesota, MN.* 8th January 2015.

9. **Bateman MG,** Creaven M, Howard B, Quill JL, Hill AJ. "Defining the Transcatheter Mitral Valve Delivery System Pathway in the Severe FMR Patient Population." Invited lecture: *Science and Technology Conference 2014, Medtronic, Inc. Minneapolis, MN.* 28th October 2014.

10. **Bateman MG**, Skadsberg ND. "3D Electrophysiologic Cardiac Mapping" Guest Lecture: *"Advanced Cardiac Physiology & Anatomy Course, University of Minnesota, MN.* 10th January 2014.

11. Suardini D, **Bateman MG,** Schendel M, Schotzko L, Quill JL. "Tensile Behavior of Fresh and Formalin Fixed Porcine and Ovine Mitral Valve Chordae Tendineae." Invited lecture: *Science and Technology Conference 2013, Medtronic, Inc. Minneapolis, MN.* 23rd October 2013.

12. **Bateman MG**. "Cardiac Anatomy and Pathology in Relation to Valve Repair and Replacement." Session Chair: *Design of Medical Devices Conference 2013, Minneapolis, MN.* 10th April 2013.

13. **Bateman MG**, He B, Iaizzo PA. "The Use of Cardiac Electrical Mapping Technologies for in situ and in vitro Studies within the Visible Heart® Laboratory." Invited lecture: *Design of Medical Devices Conference 2012, Minneapolis, MN.* 11th April 2012.

14. **Bateman MG**, Spencer JH. "Investigating Cardiac Anatomy via 3D Anatomical Modelling" Guest Lecture: *"Advanced Cardiac Physiology & Anatomy Course, University of Minnesota, MN.* 13th January 2012.

15. **Bateman MG**. "The Use of High Resolution Imaging and 3D Reconstruction Software in the Study of Human Cardiac Anatomy" Guest lecture: *Materialise Innovation Conference, RAPID, Minneapolis, MN.* 25th May 2011.

16. **Bateman MG**, Eggen MD, Iaizzo PA. "Methods to Prepare Perfusion Fixed Cardiac Specimens for Multimodal Imaging: the Use of Formalin and Agar Gels" Invited lecture: *Design of Medical Devices Conference 2011, Minneapolis, MN. 14th* April 2011.

17. **Bateman MG**. "Physiological Engineering within The Visible Heart® Laboratory: "Using Swine Hearts to Save Human Lives"." Guest lecture: *Worthington BioSciences Conference, Worthington, MN.* 8th April 2011.

TEACHING AND CURRICULUM DEVELOPMENT

University of Minnesota as Assistant Professor

Sep 2018-May 2019/ ***Faculty*****/** New Product Design and Business Development (BMEN 8401-8402, ENTR 6041-6042, ME 8221-8222) http://www.npdbd.umn.edu/home
Sep 2017-May 2018/ ***Faculty*****/** New Product Design and Business Development (BMEN 8401-8402, ENTR 6041-6042, ME 8221-8222) http://www.npdbd.umn.edu/home

University of Minnesota as a Research Assistant

Jan 2012/ ***Teaching Assistant & Lecturer***/ Advanced Cardiac Anatomy and Physiology (PHSL 5510)
Oct 2011/ ***Lecturer***/ Physiology Laboratory (PHSL 3063)
Jan 2011/ ***Teaching Assistant***/ Advanced Cardiac Anatomy and Physiology (PHSL 5510)
Oct 2010/ ***Lecturer***/ Physiology Laboratory (PHSL 3063)
Jan-May 2010/ ***Teaching Assistant***/ Biomedical Engineering Design II (BMEN 4002)
Jan 2010/ ***Teaching Assistant***/ Advanced Cardiac Anatomy and Physiology (PHSL 5510)
Sep-Dec 2009/ ***Lecturer***/ Physiology Laboratory (PHSL 3063)
Sep-Dec 2009/ ***Teaching Assistant***/ Biomedical Engineering Design I (BMEN 4001)
Aug 2009/ ***Teaching Assistant***/ Neuroscience Introductory Course (Neuro-muscular junction module) (NSC 5551)
Jan 2009/ ***Teaching Assistant***/ Advanced Cardiac Anatomy and Physiology (PHSL 5510)
Sep-Dec 2008/ ***Teaching Assistant***/ Lecturer/Physiology Laboratory (PHSL 3063)
Jul-Aug 2008/ ***Teaching Assistant***/ Neuroscience Introductory Course (Neuro-muscular junction module) (NSC 5551)
Sep-Dec 2007/ ***Teaching Assistant***/ Biomechanics (BMEN 3001)

Medtronic as an Invited Lecturer

Dec 7th 2016/ ***Teaching Assistant***/ Beaumont Fellow's Heart Anatomy Dissection Course, Beaumont Hospital, Detroit, MI
Sep 23rd 2015/ ***Teaching Assistant***/ Beaumont Fellow's Heart Anatomy Dissection Course, Beaumont Hospital, Detroit, MI

Advising and Mentoring

University of Minnesota

Master's Student Advisees:

1. **Ky O'Rourke,** University of Minnesota (11/17 to Present)
2. **Tommy Valenzuaela III,** University of Minnesota (9/17 to 8/18), accepted to the BMEn PhD program at University of Minnesota.
3. **Lindsey Arndt,** University of Minnesota (9/17 to 5/18)), now employed at Medtronic.
4. **Sarah Hamlin,** University of Minnesota (9/17 to 5/18)
5. **Angela Burgess,** University of Minnesota (9/17 to 5/18)), now employed at Medtronic.
6. **Ivan Akunovich,** Medtronic, Inc., Minneapolis (9/11 to 5/12)
7. **Amanda Wilson,** Medtronic, Inc., Minneapolis (9/10 to 5/12)

Volunteer Student Advisees:

1. **Kendall Emfield,** Volunteer (6/18 to Present)
2. **Windy Zheng,** Volunteer (6/18to Present)
3. **Rohan Thakur,** Volunteer (6/18 to Present)
4. **Mahdi Hurreh**, Volunteer (9/17 to Present)
5. **Danielle Sorensen,** Volunteer (9/17 to Present)
6. **Claire Thomas**, Volunteer (9/17 to Present)
7. **Nichole Torgerson**, Volunteer (9/17 to Present)
8. **Tarek Khatib**, Volunteer (9/17 to Present)

9. **Beth Kregel,** Volunteer (9/10 to 5/12)
10. **Lesa Nord,** Volunteer (6/10 to 5/12)
11. **Kiley Schmidt,** Volunteer/UROP (1/10 to 5/12)
12. **Jack Trebelhorn,** Volunteer (9/10 to 5/11)
13. **John Uphoff,** Volunteer (11/09 to 5/11)
14. **Maria Zaumer,** LSSURP student (6/10 to 12/10)
15. **Maria LaNasa,** Volunteer (7/09 to 9/10)
16. **Amelia Raether,** Volunteer (6/10 to 9/10)
17. **Jessica Reynertson,** Volunteer (1/09 to 5/10)
18. **Michael Schnaus,** Volunteer (6/09 to 12/09)
19. **Nolan Turner,** Volunteer (5/09 12/09)
20. **Aaron Barlow,** Volunteer (1/09 to 12/09)
21. **Gia Fedo,** Volunteer (10/08 to 12/09)
22. **Jessica Felton,** Volunteer (1/09 to 5/09)
23. **Geoffrey Cherucheril,** Volunteer (2/08 to 5/09)

Medical Student Advisees:

1. **Steve Conlon,** University of Minnesota School of Medicine (1/12 to 5/12)
2. **Allison Bradee,** University of Minnesota School of Medicine (11/11 to 5/12)
3. **Chad Thompson,** University of Minnesota School of Medicine (11/11 to 5/12)
4. **Devon Hutton,** University of Minnesota School of Medicine (8/10 to 6/11)
5. **Brian Chan,** University of Minnesota School of Medicine (6/09 to 9/10)
6. **Cori Russell,** University of Minnesota School of Medicine (5/09 to 9/10)

Medtronic, PLC

High School Student Mentees:

1. **Arunima Bhattacharya**, Eagan High School, (9/16 to 12/16)
2. **Sam Deisz,** Eagan High School, (1/16 to 4/16)
3. **McKenna Mayne,** Eagan High School, (1/16 to 4/16)
4. **Rachel Schornak,** Eagan High School, (9/13 to 12/13)

Graduate Intern Advisees:

1. **Lars Mattison,** University of Minnesota, MN (2015 – 2017), completing PhD studies in the BMEn program at University of Minnesota.
2. **Stephen Quallich,** University of Minnesota, MN (2014 – 2015), now employed at Medtronic.
3. **Brian Howard,** University of Minnesota, MN (2013 – 2015), now employed at Medtronic.
4. **Julianne Spencer,** University of Minnesota, MN (2012 – 2013), now employed at Medtronic.