Thomas D. **Lehmann**

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Education

University of Alberta, Department of Electrical and Computer Engineering
Edmonton, Canada

PhD in Biomedical Engineering
Sept. 2013 - Jan. 2018

Areas of study and research: Medical robotics, biomedical engineering, mechanics-based modeling, needle insertion, needle steering, needle deflection modeling, sensing and estimation

Furtwangen University
Schwenningen, Germany

MSc in Biomedical Engineering
Oct. 2011 - Jun. 2013

- *Areas of study and research*: Physiological modeling, simulation, machine learning, decision support systems for medical ventilation of patients

Furtwangen University
Schwenningen, Germany

BSc in Medical Engineering
Mar. 2007 - Mar. 2011

- *Areas of study*: Biomedical Technology

Work and Research Experience

Additive Design and Manufacturing Systems Lab, MECE Department, University of Alberta
Edmonton, Canada

Postdoctoral Researcher
Jan. 2019 - PRESENT

- Research on robot-assisted large-scale metal additive manufacturing
- Procurement and commissioning of robotic systems for metal additive manufacturing
- Supervision of various projects related to robotics and mechatronics

Additive Design and Manufacturing Systems Lab, MECE Department, University of Alberta
Edmonton, Canada

Research Assistant
Oct. 2018 - Dec. 2018

- Research on robot-assisted large-scale metal additive manufacturing
- Procurement and commissioning of robotic systems for metal additive manufacturing

Telerobotic and Biorobotic Systems Lab, ECE Department, University of Alberta
Edmonton, Canada

Research Assistant/Software Developer
Feb. 2018 - PRESENT

- Introduction of the robot middleware *Robot Operating System* (ROS) to the Telerobotic and Biorobotic Systems Lab
- Developing hardware drivers for interfacing hardware such as robots, haptic devices, force/torque sensors, motion tracking and imaging systems with ROS
- Developing communication interfaces between ROS and non-ROS hardware and software
- Contributions to the robotics software project *ros-industrial* (ros-industrial/motoman, ros-industrial/motoman-experimental)

Telerobotic and Biorobotic Systems Lab, ECE Department, University of Alberta
Edmonton, Canada

Research Assistant
Sep. 2013 - Jan. 2018

- Research for PhD thesis topic: Novel sensing and actuation methods for needle steering in soft tissue with application to prostate brachytherapy
- Developing novel methods for deflection estimation of a bevel-tipped needle during insertion
- Developing mathematical models that represent physical interactions between needle and tissue
- Development of model-based control algorithms for needle steering
- Development a novel actuation method for needle steering
- Development of a robotic assistance system for needle insertion (including design of mechanical system, electronics, data acquisition and software)
- Publication and presentation of original research in peer-reviewed journals and conferences, respectively
- Supervision and co-supervision of multiple undergraduate students and interns assisting with projects related to the above research topics

Department of Electrical and Computer Engineering, University of Alberta — *Edmonton, Canada*

Teaching Assistant — *Sep. 2014 - Dec. 2017*

- Responsibilities: Instruction/supervision of laboratory and report/assignment grading
  - *Fall Term 2014*: ECE 210 – Introduction to Digital Logic Design
  - *Winter Term 2015*: ECE 212 – Introduction to Microprocessors
  - *Fall Term 2015, 2016 & 2017*: ECE 464 – Medical Robotics
  - *Winter Term 2016 & 2017*: ENCMP 100 – Computer Programming for Engineers

Institute of Technical Medicine (ITeM), Furtwangen University — *Schwenningen, Germany*

Research Assistant — *Mar. 2013 - Aug. 2013*

- Design and implementation of a Java-based patient simulator
- Re-implementation of various mathematical models of the cardiovascular system, heart, and respiratory system
- Design of model interfacing and inheritance structure

Telerobotic and Biorobotic Systems Lab, ECE Department, University of Alberta — *Edmonton, Canada*

Research Assistant — *Sep. 2012 - Feb. 2013*

- Research for Machelor's thesis titled: Development of an Intelligent Surgeon's Assistant for Needle Adjustment in Prostate Brachytherapy
- Development of a virtual sensor for estimating needle deflection during insertion into soft tissue
- Design of an experimental setup for automated needle insertion

Institute of Technical Medicine (ITeM), Furtwangen University — *Schwenningen, Germany*

Research Assistant — *Nov. 2011 - Aug. 2012*

- Implementation of a Java-based tool for real-time plotting of a ventilation support siulator for Android mobile devices

University of Canterbury — *Christchurch, New Zealand*

Visiting Student — *Oct. 2010 - Mar. 2011*

- Research for Bachelor's thesis titled: "Software Development for an Autonomously Operating Robot Truck for the Location and Recovery of Objects"
- Research and development of image processing methods for object detection under noisy conditions
- Development of a state-machine-based algorithm for automatic manouvering and decision making

Aesculap AG — *Tuttlingen, Germany*

Intern — *Mar. 2009 - Aug. 2009*

- Development of microcontroller software in C for automatic detection of various types of surgical drills
- Design and assembly of electronic circuits

Publications

Journals

[1] *T. Lehmann*, R. Sloboda, N. Usmani, and M. Tavakoli, "Human-machine collaboration modalities for semi-automated needle insertion into soft tissue," IEEE Robotics and Automation Letters, vol. 3, no. 1, pp. 477–483, 2018.

[2] *T. Lehmann*, C. Rossa, N. Usmani, R. Sloboda, and M. Tavakoli, "Intraoperative Tissue Young's Modulus Identification During Needle Insertion Using a Laterally Actuated Needle," IEEE Transactions on Instrumentation and Measurement, vol. 67, no. 2, pp. 371–381, 2018.

[3] *T. Lehmann*, C. Rossa, N. Usmani, R. Sloboda, and M. Tavakoli, "Deflection modeling for a needle actuated by lateral force and axial rotation during insertion in soft phantom tissue," Mechatronics, vol. 48, pp. 42–53, 2017.

[4] *T. Lehmann*, C. Rossa, N. Usmani, R. Sloboda and M. Tavakoli. "A real-time estimator for needle deflection during insertion into soft tissue based on adaptive modeling of needle-tissue interactions". IEEE/ASME Transactions on Mechatronics, vol. 21, issue 6, pp. 2601–2612, 2016.

[5] C. Rossa, *T. Lehmann*, R. Sloboda, N. Usmani and M. Tavakoli. "A data-driven soft sensor for needle deflection in heterogeneous tissue using just-in-time modelling". *Medical & Biological Engineering & Computing*, pp. 1–14, 2016.

[6] J. Kretschmer, B. Laufer, *T. Lehmann*, P. Stehle, D. Redmond, and K. Möller. "Ein softwarebasierter Patientensimulator zur Evaluierung medizinischer Entscheidungssysteme (A software-based patient simulator to evaluate medical decision support systems)". *at – Automatisierungstechnik*, vol. 64, issue 11, pp. 878–893, 2016.

[7] *T. Lehmann*, M. Tavakoli, N. Usmani and R. Sloboda. "Force-Sensor-Based Estimation of Needle Tip Deflection in Brachytherapy". *Journal of Sensors*, vol. 2013, 2013.

Conferences (peer-reviewed)

[8] *T. Lehmann*, C. Rossa, N. Usmani, R. Sloboda and M. Tavakoli. "Needle path control during insertion in soft tissue using a force-sensor-based deflection estimator". *Proceedings of the 2016 IEEE International Conference on Advanced Intelligent Mechatronics*, Banff, Canada, July 12–15, 2016, pp. 1174–1179.

[9] J. Kretschmer, *T. Lehmann*, D. Redmond, P. Stehle and K. Möller, "A Modular Patient Simulator for Evaluation of Decision Support Algorithms in Mechanically Ventilated Patients", XIV Mediterranean Conference on Medical and Biological Engineering and Computing 2016 (MEDICON 2016), 2016.

[10] *T. Lehmann*, C. Rossa, N. Usmani, R. Sloboda and M. Tavakoli. "A virtual sensor for needle deflection estimation during soft-tissue needle insertion". *Proceedings of the 2015 IEEE International Conference on Robotics and Automation*, Seattle, USA, 2015, pp. 1217–1222.

Skills

Programming languages	C/C++, Java (Java SDK, Android SDK), Python, JavaScript, MATLAB/Simulink
Development environments	eclipse, Qt, Visual Studio
Software frameworks/libraries/tools	ROS, MoveIt!, Robot Web Tools, Qt
Operating systems	Linux (Debian, Ubuntu), MS Windows
CAD, rapid prototyping	SolidWorks
Documentation, word processing, productivity	LaTeX, MS Office, LibreOffice, Google Suite, Inkscape
Version control	Git, Apache Subversion
Languages	German (native), English

Awards

2013 **Doctoral Recruitment Scholarship,** *University of Alberta*

2015 **Graduate Travel Award,** *University of Alberta*

2016 **Graduate Travel Award,** *University of Alberta*

2018 **Travel Award,** *International Symposium on Medical Robotics*

Presentations

The 2015 IEEE International Conference on Robotics and Automation (ICRA) *Seattle, USA*

Presented paper titled "A virtual sensor for needle deflection estimation during soft-tissue needle insertion" *May 2015*

The 2016 IEEE International Conference on Advanced Intelligent Mechatronics (AIM) *Banff, Canada*

Presented paper titled "Needle path control during insertion in soft tissue using a force-sensor-based deflection estimator" *Jul. 2016*

The International Symposium on Medical Robotics (ISMR 2018) *Atlanta, USA*

Presented poster titled "Intraoperative Identification of Tissue Young's Modulus During Prostate Brachytherapy" *Mar. 2018*