

Mohamad T. Shahab

Curriculum Vitae

Current Address (Work): 4700 King Abdullah University of Science and Technology, Thuwal 23955, Saudi Arabia

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Education

University of Waterloo

- *Doctor of Philosophy (PhD), Electrical and Computer Engineering* 2020

Thesis: "A New Approach to Multi-Model Adaptive Control"

Supervisor: Prof. Daniel E. Miller

Committee: Prof. João Hespanha, Prof. Christopher Nielsen, Prof. Andrew Heunis, Prof. Barış Fidan

King Fahd University of Petroleum and Minerals (KFUPM)

- *Master of Science (MSc), Systems Engineering (Automation & Control)* 2015

Thesis: "Time-energy Optimization of Motion of Multi-robot System"

Supervisor: Prof. Moustafa Elshafei

Committee: Prof. Abdul-Wahid A. Saif, Prof. Muhammad Mysorewala

King Fahd University of Petroleum and Minerals (KFUPM)

- *Bachelor of Science (BSc), Control & Instrumentation Systems Engineering, Honors* 2007

Senior Project: "Design of a Rotational Speed Measurement System by Computer Vision for Quality Testing"

Supervisor: Prof. Sami El-Ferik

Selected Coursework

- Graduate: Linear Systems, Nonlinear Systems, Adaptive Control, Stochastic Control, Robotics & Control, Control of Distributed Parameter Systems, Digital Signal Processing, Systems Identification.
- Undergraduate: Linear Control Systems, Digital Control Systems, Mechatronics, Intro to Robotics, Instrumentation, Process Control, Operations Research, Optimization Methods.

Research Interests

- Adaptive Control
- Robotics
- Learning-based Control
- Autonomous Systems
- Optimization & Control
- Control under Uncertainty

Appointments

Academic experience

King Abdullah University of Science and Technology (KAUST)

- *Research Specialist* Saudi Arabia Nov 2022–Present
- *Postdoctoral Fellow* Nov 2020–Nov 2022
- *Remote Postdoctoral Fellow (Waterloo, ON, Canada)* Jul 2020–Nov 2020

Supervisor: Prof. Eric Feron. Affiliated with the Robotics, Intelligent Systems, and Control (RISC) Lab at the Computer, Electrical and Mathematical Science and Engineering (CEMSE) Division. Involved in a project on a modular unmanned aerial system, namely an assembly of tetrahedral shaped autonomous quadrotor modules under uncertainty.

- **University of Waterloo** **Canada**
Research & Teaching Assistant / PhD Student *Jan 2016–Jun 2020*
 Department of Electrical and Computer Engineering
- **King Fahd University of Petroleum and Minerals (KFUPM)** **Saudi Arabia**
Research Assistant *Sep 2007–Jun 2011*
 Systems Engineering Department (Now called Control & Instrumentation Engineering Department)

Industrial experience.....

- **Baker Hughes** **Saudi Arabia**
Research & Development Engineer *Jan 2012–Dec 2015*
 Member of the Geoscience R&D team at the Dhahran Technology Center. Applied Machine Learning techniques on oil & gas formation evaluation, integrating well-log data processing & petrophysical interpretation.
- **Nesma Trading Co. Ltd.** **Saudi Arabia**
Intern *Jun 2006–Aug 2006*
 Worked on Building Management Systems (BMS) and HVAC Control.

Teaching

Teaching training.....

- **Harvard University**
Higher Education Teaching Certificate *2021*
 Derek Bok Center for Teaching & Learning online short course
- **University of Waterloo**
Fundamentals of University Teaching Certificate *2020*
 Centre for Teaching Excellence

Teaching experience.....

- **KAUST**
Informal teaching assistant
 AMCS 394L: Topics in Dynamics and Control *Spring 2023*
- **University of Waterloo**
Teaching assistant
 SE 380: Introduction to Feedback Control *Fall 2019*
 ECE 380: Analog Control System *Spring 2019*
 ECE 204: Numerical methods *Winter 2019*
 SE 380: Introduction to Feedback Control *Fall 2018*
- **KFUPM**
Teaching assistant/Lab instructor
 ISE 307: Engineering Economics Analysis *Summer 2010*
 CISE 318: Computer (Digital) Control Systems *Spring 2010*
 CISE 313: Automation Devices & Electronics *Fall 2009*
 CISE 301: Numerical Methods *Summer 2009*
 CISE 312: Instrumentation *Spring 2009*
 CISE 318: Computer (Digital) Control Systems *Fall 2008*
 SE 439: Condition Based Maintenance *Spring 2008*
 SE 438: Instrumentation for Process Control *Fall 2007*

Grants & Funding

- SDAIA-KAUST Center of Excellence in Data Science and Artificial Intelligence grant (~ 53,000 USD). Jul 2023-Jul 2024, "High-speed Computer Vision Technique for Autonomous Underwater Surveys" Co-PIs: Eric Feron, Mohamad T. Shahab.
- KAUST Conferences and Workshops Support program (~ 170,000 USD). "KAUST Research Conference on Robotics and Autonomy 2024," Organizing Committee: Eric Feron, Shinkyu Park (Mohamad T. Shahab co-wrote proposal).

Awards & Scholarships

- Faculty of Engineering Award, University of Waterloo Graduate Scholarship, 2019.
- Graduate Research Studentship, University of Waterloo, 2016-2020.
- Engineering Domestic Doctoral Student Award, University of Waterloo, 2018-2019.
- International Doctoral Student Award, University of Waterloo, 2016-2017.
- Master's study Research Assistantship, KFUPM, 2007-2011.
- Honor List (undergraduate degree), KFUPM, 2007.
- Term Distinction Award (Six times), KFUPM, 2003-2007.
- Undergraduate study full scholarship for non-citizen residents, KFUPM, 2003-2007.

Publications

Google Scholar profile: <https://scholar.google.ca/citations?user=Kk0QTh4AAAAJ>

Journal papers

- [6] **Shahab, M.T.**, Miller, D.E., "Asymptotic tracking and linear-like behavior using multi-model adaptive control," *IEEE Transactions on Automatic Control*, vol. 67, no. 1, pp. 203–219, 2022.
- [5] **Shahab, M.T.**, Miller, D.E., "Adaptive control of a class of discrete-time nonlinear systems yielding linear-like behavior," *Automatica*, vol.130, p.109691, 2021.
- [4] Miller, D.E., **Shahab, M.T.**, "Linear-like properties arise naturally in the adaptive control setting," *International Journal of Adaptive Control and Signal Processing*, vol. 35, no. 6, pp. 965–990, 2021.
- [3] Miller, D.E., **Shahab, M.T.**, "Adaptive tracking with exponential stability and convolution bounds using vigilant estimation," *Mathematics of Control, Signals, and Systems*, vol. 32, no. 3, pp. 241–291, 2020.
- [2] Miller, D.E., **Shahab, M.T.**, "Classical pole placement adaptive control revisited: Linear-like convolution bounds and exponential stability," *Mathematics of Control, Signals, and Systems*, vol. 30, no. 4, p. 19, 2018.
- [1] Khoukhi, A., **Shahab, M.T.**, "Stabilized feedback control of unicycle mobile robots," *International Journal of Advanced Robotic Systems*, vol. 10, no. 4, p. 187, 2013.

Conference papers

- [13] Wali, O., **Shahab, M.T.**, Feron, E., "A Non-planar Assembly of Modular Tetrahedral-shaped Aerial Robots," *2023 IEEE International Conference on Robotics and Automation (ICRA)*.
- [12] **Shahab, M.T.**, Wali, O., Feron, E., "Automatic Identification of a Modular Unmanned Aerial System (UAS) with Experimental Verification," *2023 AIAA SciTech Forum*.
- [11] Alomar, I., Alhani, F., Alfaadehl A., Shageer, H., Feron, E., **Shahab, M.T.**, "Run-Time Assurance via Real-time Generation of Backup Trajectories and Transverse Dynamics Regulation Laws," *2023 AIAA SciTech Forum*.
- [10] **Shahab, M.T.**, Garanger, K., Feron, E., "Control of an assembly of aerial vehicles under uncertainty," in *2022 American Control Conference (ACC)*, 2022, pp. 514-519.
- [9] **Shahab, M.T.**, Miller, D.E., "Model reference adaptive control with linear-like closed-loop behavior," in *IEEE 60th Conference on Decision and Control (CDC)*, 2021, pp. 1069–1074.
- [8] **Shahab, M.T.**, Miller, D.E., "The inherent robustness of a new approach to adaptive control," in *2020 IEEE Conference on Control Technology and Applications (CCTA)*, 2020, pp. 510–515.

- [7] **Shahab, M.T.**, Miller, D.E., "Adaptive set-point regulation using multiple estimators," in *2019 IEEE 58th Conference on Decision and Control (CDC)*, 2019, pp. 84–89.
- [6] **Shahab, M.T.**, Miller, D.E., "Exponential stability for adaptive control of a class of first-order nonlinear systems," *IFAC-PapersOnLine*, vol. 52, no. 29, pp. 168–173, 2019, 13th IFAC Workshop on Adaptive and Learning Control Systems ALCOS 2019.
- [5] Miller, D.E., **Shahab, M.T.**, "Classical d-step-ahead adaptive control revisited: Linear-like convolution bounds and exponential stability," in *2019 American Control Conference (ACC)*, 2019, pp. 417–422.
- [4] **Shahab, M.T.**, Miller, D.E., "Multi-estimator based adaptive control which provides exponential stability: The first-order case," in *2018 IEEE Conference on Decision and Control (CDC)*, 2018, pp. 2223–2228.
- [3] **Shahab, M.T.**, Jin, G., Negara, A., Agrawal, G., "New data-driven method for predicting formation permeability using conventional well logs and limited core data," in *SPE Kingdom of Saudi Arabia Annual Technical Symposium and Exhibition*, SPE-182826-MS, Apr. 2016.
- [2] **Shahab, M.T.**, Doraiswami, R., "A novel two-stage identification of unstable systems," in *2009 IEEE International Conference on Control and Automation*, 2009, pp. 1043–1048.
- [1] **Shahab, M.T.**, Doraiswami, R., "Identification of a class of unstable processes," in *2009 5th IEEE GCC Conference & Exhibition*, 2009, pp.1–4.

Book chapter(s).....

- [2] Maassarani, B., Garanger, K., Epps, J., **Shahab, M.T.**, Wali, O., Feron, E., "Tetrahedral and Dodecahedral UASs, structured designs," in *Unmanned Aerial Vehicles Applications: Challenges and Trends*, M. Abdelkader, A. Koubaa, Eds., Springer. (To appear)
- [1] **Shahab, M.T.**, Elshafei, M., "Distributed optimization of multi-robot motion with time-energy criterion," in *Path Planning for Autonomous Vehicle*, U.Z.A. Hamid, V. Sezer, B. Li, Y. Huang, and M.A. Zakaria, Eds., Rijeka:IntechOpen, 2019, ch. 8.

Abstracts & Preprints.....

- [4] **Shahab, M.T.**, Miller, D.E., "A Convolution Bound Implies Tolerance to Time-variations and Unmodelled Dynamics," *arXiv:1910.02112*, 2019.
- [3] **Shahab, M.T.**, "Multi-Estimator-Based Adaptive Control Which Provides Exponential Stability: The First-Order Case," in *8th Meeting on Systems and Control Theory*, Toronto, Canada, 2018.
- [2] **Shahab, M.T.**, Jin, G., Agrawal G., "Total Organic Carbon Prediction from Well Logs Using the Support Vector Regression Technique," in *12th Middle East Geosciences Conference & Exhibition*, 2016.
- [1] **Shahab, M.T.**, Khoukhi, A., Al-Sunni, F., "Time-Energy Optimal Control of a Mobile Robot Using Direct Numerical Method," *arXiv:1312.7088*, 2013. Note: accepted to the 19th Mediterranean Conference on Control and Automation (MED 2011), Corfu, Greece, but later withdrawn.

Under review.....

- **Shahab, M.T.**, Miller, D.E., "Inherent Robustness in Adaptive Control," *International Journal of Adaptive Control and Signal Processing*, (Under Review).
- **Shahab, M.T.**, Miller, D.E., "Revisiting Model Reference Adaptive Control: Linear-like Closed-loop Behavior," *IEEE Transactions on Automatic Control*, (Under Review).

Theses.....

- PhD Thesis: **M.T. Shahab**. (2020) "A New Approach to Multi-Model Adaptive Control." *University of Waterloo*.
- Master's Thesis: **M.T. Shahab**. (2014) "Time-energy Optimization of Motion of Multi-robot System." *King Fahd University of Petroleum & Minerals*.
- Senior Project: **M.T. Shahab**, I. Al-Safadi. (2007) "Design of a Rotational Speed Measurement System by Computer Vision for Quality Testing." *King Fahd University of Petroleum & Minerals*.

Coursework technical reports.....

- "Control of Flexible Two-Link Robotic Manipulator." 2016.
- "Optimization of Filter Design for Wavefield Extrapolation." 2010.
- "Fault Diagnosis: a Dempster-Shafer Theory Approach." 2009.
- "Energy-Efficient Motion Control of Mobile Robots." 2009.
- "Robot Self-Localization in a Known Environment." 2008.
- "Cooperative Control of Multi-Vehicle Systems." 2008.
- "Optimal Control of Robotic Wheelchair." 2008.

Talks & Presentations

**excluding conference paper presentations.*

- "A New Approach to Multi-Model Adaptive Control." hosted by the Autonomous Systems Laboratory (ASL), Stanford University, Stanford, CA, USA. *Jun 2022.*
- "An Application of Multi-Model Adaptive Control." **Virtual**, ME Seminar at King Abdullah University of Science and Technology (KAUST). *Oct 2021.*
- "A New Approach to Multi-Model Adaptive Control." **Virtual**, hosted by the Advanced Controls Research Laboratory, University of Illinois at Urbana-Champaign. *Jul 2021.*
- "A New Approach to Multi-Model Adaptive Control." **Virtual**, hosted by Eric Feron, King Abdullah University of Science and Technology (KAUST). *Jun 2020.*
- "Step Tracking using Multi-Model Adaptive Control." Seminar at the Department of Electrical and Computer Engineering, University of Waterloo, Waterloo, ON, Canada. *Mar 2020.*
- "Multi-Estimator-Based Adaptive Control Which Provides Exponential Stability: The First-Order Case." at the 8th Meeting on Systems and Control Theory, University of Toronto, Toronto, ON, Canada. *May 2018.*
- "Multi-objective Optimal Control of a Group of Cooperating Mobile Robots." at the 6th Symposium on Industrial Systems and Control, King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia. *May 2010.*
- "Identification of Complex Practical Processes." at the 5th Workshop on Industrial Systems and Control, King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia. *Nov 2008.*
- "Design of a Rotational Speed Measurement System using Machine Vision for Quality Testing." at the 5th Workshop on Industrial Systems and Control, King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia. *Nov 2008.*

Mentorship

- Obadah Wali, PhD student, Mechanical Engineering, KAUST. 2021-Present.
- Dania Abed Aljawad, Intern, Baker Hughes. Summer 2015. (Last known position: Learning Experience Design Manager, Udacity)
- Dean Magara, Intern, RISC Lab, KAUST. Summer 2022.
- Hannan Mohiuddin, Intern, RISC Lab, KAUST. Summer 2022.
- General academic advising to several other students.

Service & Professional Activities

Memberships.....

- **Institute of Electrical and Electronics Engineers (IEEE)**
 - *Regular Member (2021-Present), Student Member (2018-2020)*
 - Member, Control Systems Society
 - Member, Robotics and Automation Society
- **International Federation of Automatic Control (IFAC)**
 - *Affiliate Member (2021-Present)*

Academic Service.....

- Lead, organization team, 2023 KAUST Research Conference on Robotics and Autonomy, May 2023.
Responsibilities include:
 - Main contact point for all aspects for organizing the conference
 - Coordinating with the Organizing Committee
 - Managing speaker invitations and follow-up
 - Managing conference website: <https://cemse.kaust.edu.sa/robotokaust>
 - Preparing the Call for Posters, Call for Abstracts, and coordinating announcements
 - Coordinating with team with respect to travel, hotel, and conference venue arrangements
 - Coordinating with team the poster session, and gifts and certificates
- Coordinator, poster session, 2022 KAUST Research Conference on Robotics and Autonomy, Mar 2022.
- Session Co-chair (informal replacement), 60th IEEE Conference on Decision and Control, Dec 2021.
- Judge, poster sessions, KAUST Research Open Week, Nov 2021.
- Session Co-chair, 2021 KAUST Research Conference on Robotics and Autonomy, Mar 2021.
(Check <https://youtu.be/852gl2M8KJA>)
- Volunteer, 4th Workshop on Industrial Systems and Control, KFUPM, 2007.
- Invited to a discussion session with KFUPM International Advisory Board, 2007.

Outreach.....

- Involved in recruiting and supervising interns as part of KAUST “Work Internship, Student Experience (WISE)” program in coordination with The KAUST School, Summer 2022.
- Lead the effort at the Robotics, Intelligent Systems, and Control (RISC) Lab at KAUST to organize robotics demonstrations to local schools students. Part of the KAUST Research Open Week, Nov 2021. (Featured in <https://youtu.be/-SqPTKHw6MM?t=20640>, at the 05:44:00 timestamp)
- Referee, “Junior RoboCup Football League”, Khobar, Saudi Arabia, 2009. Local schools robotics competition.

Reviewer.....

- IEEE Transactions on Automatic Control
- Automatica
- IEEE Robotics and Automation Magazine
- IEEE Conference on Decision and Control (CDC)
- American Control Conference (ACC)
- European Control Conference (ECC)
- IFAC World Congress
- IEEE Conference on Control Technology Applications (CCTA)
- Sensors
- Journal of Systems and Control Engineering
- IEEE Access
- Asian Journal of Control
- IEEE GCC Conference and Exhibition

Other Research work & Training

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| University of Waterloo | Waterloo, ON, Canada |
| ○ <i>Enhanced adaptive control for robotic applications</i> | 2016-2017 |
| Under supervision of Daniel E. Miller and in partnership with MDA Ltd. (formerly MacDonald, Dettwiler and Associates). | |
| Baker Hughes | Dhahran, Saudi Arabia |
| ○ <i>Introduction to Stochastic Models in Formation Evaluation</i> | 2015 |
| Baker Hughes | Houston, TX, USA |
| ○ <i>Geoscience Academy (Five weeks)</i> | 2014 |
| Baker Hughes | Dubai, UAE |
| ○ <i>Engineer Development Program (Two weeks)</i> | 2012 |

Technical Skills

- Robot Operating System (ROS), PX4 Autopilot
- MATLAB, Octave, LabVIEW
- Python, C/C++ language, Assembly language
- Oil & Gas software: Workflow Manager, Techlog
- LaTeX, Microsoft Word, PowerPoint, Excel, and Outlook, Zoom, WebEx

References

- References are available upon request.