

# Melih Can Yesilli

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## EDUCATION

**Michigan State University**, East Lansing, MI

August 2018 – May 2022

*Doctor of Philosophy, Department of Mechanical Engineering*

Thesis Title: Topological Data Analysis and Machine Learning Framework for Studying Time Series and Image Data

Advisor: Dr. Firas Khasawneh

**Middle East Technical University**, Ankara, Turkey

September 2013 – June 2018

*Bachelor of Science, Department of Mechanical Engineering*

## WORK EXPERIENCE

**KLA Corporation**

Ann Arbor, MI

*Algorithm Engineer*

May 2022 – present

**Michigan State University**

East Lansing, MI

*Graduate Research Assistant*

August 2018 – May 2022

**Chatter Detection in Machining Using Machine Learning**

- Developed a method to classify stable and unstable time series with 96% accuracy using Topological Data Analysis and machine learning
- Designed and implemented the machine learning module for the Python package teaspoon
- Diagnosed chatter in machining signals with 98% accuracy using time series similarity measures and the K-Nearest Neighbors algorithm
- Achieved 95% accuracy in detecting unstable machining signals using a transfer learning approach

**Surface Texture Analysis Using Machine Learning**

- Reduced surface mode computation time by 96% by developing an automatic threshold selection algorithm for the Discrete Cosine Transform
- Achieved 95% classification accuracy for surface texture analysis using information theory and image processing
- Classified surface images with 96% accuracy using Topological Data Analysis

**Tool Wear Identification**

- Developed an automated algorithm to select sensitive frequencies in the Fourier spectrum for feature extraction using the Discrete Wavelet Transform
- Designed a Topological Data Analysis-based approach for tool wear analysis
- Demonstrated that expensive force sensors are redundant for the given application

**Roketsan**

Ankara, Turkey

*Engineering Trainee*

November 2017 – April 2018

- Worked on aerial vehicle navigation and Inertial Measurement Units (IMUs)
- Developed a Kalman Filter-based Attitude and Heading Reference System

*Intern*

June 2017 – July 2017

- Designed a Complementary Filter-based Attitude and Heading Reference System
- Conducted experiments using gyroscopes and accelerometers

**TEI - TUSAS Engine Industries**

Eskisehir, Turkey

*Intern*

July 2016 – August 2016

- Conducted cost analysis for two aircraft components: the front rotating air seal and the spool of a jet engine
- Inspected manufacturing processes in the factory, including milling, turning, shot peening, welding, deburring, and heat treatment

## TEACHING EXPERIENCE

**Michigan State University**

East Lansing, MI

*Graduate Teaching Assistant*

August 2018 – May 2022

- ME451L - Control Systems Laboratory (Spring 2019, Spring 2020, Spring 2022)
  - Supervised laboratory sessions and graded students' assignments
- ME461 - Mechanical Vibrations (Fall 2020)
  - Graded students' assignments and assisted with teaching materials
- ME422 - Introduction to Combustion - (Fall 2019)
  - Graded students' assignments

- ME416 - Computer Assisted Design of Thermal Systems - (Fall 2019)
  - Graded students' assignments

## **PUBLICATIONS**

### **Journal Papers**

- M. Chumley, **M. C. Yesilli**, J. Chen, F. A. Khasawneh and Y. Guo, "Pattern characterization using topological data analysis: Application to piezo vibration striking treatment," *Precision Engineering*, 2023, <https://doi.org/10.1016/j.precisioneng.2023.05.005>
- **M. C. Yesilli**, F. A. Khasawneh, B. P. Mann, "Transfer Learning for Autonomous Chatter Detection in Machining," *Journal of Manufacturing Processes*, 2022, <https://doi.org/10.1016/j.jmapro.2022.05.037>
- **M. C. Yesilli**, J. Chen, F. A. Khasawneh and Y. Guo, "Automated Surface Texture Analysis via Discrete Cosine Transform and Discrete Wavelet Transform," *Precision Engineering*, 2022, <https://doi.org/10.1016/j.precisioneng.2022.05.006>
- **M. C. Yesilli**, F. A. Khasawneh, and A. Otto, "Chatter Detection in Turning Using Machine Learning and Similarity Measures of Time Series via Dynamic Time Warping," *Journal of Manufacturing Processes*, 2022, <https://doi.org/10.1016/j.jmapro.2022.03.009>
- **M. C. Yesilli**, F. A. Khasawneh, and A. Otto, "Topological feature vectors for chatter detection in turning processes," *The International Journal of Advanced Manufacturing Technology*, 2022, <https://doi.org/10.1007/s00170-021-08242-5>
- **M. C. Yesilli**, F. A. Khasawneh, and A. Otto, "On transfer learning for chatter detection in turning using wavelet packet transform and ensemble empirical mode decomposition," *CIRP Journal of Manufacturing Science and Technology*, 2019, <https://doi.org/10.1016/j.cirpj.2019.11.003>

### **Preprints**

- **M. C. Yesilli**, R. Khawarizmi, P. Kwon, F. A. Khasawneh, "Tool Wear Identification Using Persistent Homology and Machine Learning," 2022 (*In submission*)
- A. Myers, **M. C. Yesilli**, F. A. Khasawneh, "On Time Series Methods for Chaos Detection: Application to Large Scale Double Pendulum Simulation," 2021 (*Under Review*)

### **Conference Papers**

- **M. C. Yesilli**, M. Chumley, J. Chen, F. A. Khasawneh and Y. Guo, "Exploring Surface Texture Quantification in Piezo Vibration Striking Treatment (PVST) Using Topological Measures. In International Manufacturing Science and Engineering Conference", MSEC2022, <https://doi.org/10.1115/MSEC2022-86659>.
- **M. C. Yesilli** and F. A. Khasawneh "Data-driven and Automatic Surface Texture Analysis Using Persistent Homology," In 2021 *20th IEEE International Conference on Machine Learning and Applications*, IEEE, <https://doi.org/10.1109/ICMLA52953.2021.00219>
- **M. C., Yesilli**, F. A. Khasawneh, "Data-driven Model Identification for a Chaotic Pendulum with Variable Interaction Potential". IDETC 2020, <https://doi.org/10.1115/DETC2020-22597>
- **M. C. Yesilli**, F. A. Khasawneh, "On Transfer Learning of Traditional Frequency and Time Domain Features In Turning," *15th International Manufacturing Science and Engineering Conference*, MSEC 2020. <https://doi.org/10.1115/MSEC2020-8274>
- **M. C. Yesilli**, S. Tymochko, F. A. Khasawneh, E. Munch, "Chatter Diagnosis in Milling Using Supervised Learning and Topological Features Vector," In 2019 *18th IEEE International Conference on Machine Learning and Applications*, IEEE, <https://doi.org/10.1109/ICMLA.2019.00200>
- J. R. Tempelman, A. Myers, **M. C. Yesilli**, "Experimental Investigations Into Broadband Vibration of Metastructures with Lattice Designs," In *Proceedings of the ASME International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*, IDETC2019, <https://doi.org/10.1115/DETC2019-97673>

## **PRESENTED WORK**

### **Contributed Talks**

- **Data-driven and Automatic Surface Texture Analysis Using Persistent Homology**, ICMLA 2021, December 2021
- **Chatter Detection in Turning Using Dynamic Time Warping and Approximate and Eliminate Search Algorithm**, SIAM Conference on Applications of Dynamical Systems, May 2021
- **On Transfer Learning of Traditional Frequency and Time Domain Features In Turning**, MSEC2020 (Virtual Conference), September 2020
- **Data-driven Model Identification for a Chaotic Pendulum with Variable Interaction Potential**, IDETC/MSNDC (Virtual Conference), August 2020
- **Chatter Classification and Transfer Learning in Turning Using Topological Data Analysis and Dynamic Time Warping**, MSU TDA Seminar, April 2020
- **Topological Feature Vectors for Chatter Detection in Turning Processes**, The 1st Midwest Graduate Student Conference: Geometry and Topology meet Data Analysis and Machine Learning, June 2019
- **Topological Feature Vectors for Chatter Detection in Turning Processes**, SIAM Conference on Applications of

Dynamical Systems, May 2019

- **Chatter diagnosis in turning using Topological Data Analysis**, SIAM Great Lakes Section Meeting, April 2019

#### Poster

- A.D. Myers, **M.C. Yesilli**, S. Tymochko, F. Khasawneh and E. Munch, “Teaspoon: A comprehensive python package for topological signal processing,” *Topological Data Analysis and Beyond Workshop at NeurIPS 2020*.

#### CODE AND DATA REPOSITORIES

- **M. C. Yesilli**, and F. A. Khasawneh (2022), “Persistence Diagram Computation Using Bezier Curves”, Github repository.
- **M. C. Yesilli**, and F. A. Khasawneh (2022), “Topological Saliency Library for Python Using TTK and VTK”, Github repository.
- A. Myers, **M. C. Yesilli**, S. Tymochko, F. A. Khasawneh and E. Munch, (2020), Teaspoon: A Topological Signal Processing Package, `pypi/teaspoon`.
- N. Mork, **M. C. Yesilli**, F. A. Khasawneh, (2020). Design of chaotic pendulum with a variable interaction potential, Zenodo, DOI: 10.5281/zenodo.3784897
- F. A. Khasawneh, A. Otto and **M. C. Yesilli**, (2019), “Turning Dataset for Chatter Diagnosis Using Machine Learning”, Mendeley Data, v1, <http://dx.doi.org/10.17632/hvm4wh3jzxx.1>
- **M. C. Yesilli**, F. A. Khasawneh, and A. Otto, (2019), “Machine Learning Toolbox for Machining”, Github repository.

#### CONFERENCE ACTIVITIES

- **Minisymposium Co-organizer**, *Topological Signal Processing*, SIAM Conference on Applications of Dynamical Systems, May 2021
- **Minisymposium Co-organizer**, *Topological Time Series Analysis*, SIAM Conference on Mathematics of Data Science, May 2020 (*canceled due to COVID-19*)
- **Session Chair**, SIAM Conference on Applications of Dynamical Systems, May 2021
- **Session Chair**, SIAM Conference on Applications of Dynamical Systems, May 2019

#### SERVICE

- **Reviewer**, Journal of Nondestructive Evaluation January 2025
- **Reviewer**, Journal of Intelligent Manufacturing October 2023
- **Reviewer**, Journal of Intelligent Manufacturing May 2023
- **Reviewer**, Journal of Intelligent Manufacturing July 2022
- **Reviewer**, Journal of Intelligent Manufacturing July 2021
- **Reviewer**, Journal of Intelligent Manufacturing May 2021
- **Reviewer**, SoftwareX February 2021
- **Reviewer**, Journal of Ambient Intelligence and Humanized Computing September 2020
- **Reviewer**, Measurement June 2020

#### PROFESSIONAL AFFILIATIONS & ORGANIZATIONS

- **Member**, Association for Computing Machinery (ACM) March 2021 – March 2022
- **Member**, American Society of Mechanical Engineers (ASME) October 2019 – October 2021
- **Event Coordinator**, Michigan State University Turkish Student Association (MSU-TSA) June 2021 – February 2022
- **Treasurer**, Michigan State University Turkish Student Association (MSU-TSA) April 2019 – June 2021
- **Member**, Society for Industrial and Applied Mathematics (SIAM) November 2018 – May 2022

#### LEADERSHIP

- *Graduate Student Mentor for ACRES-REU* May 2021 – July 2021
- Co-mentored two undergraduate students participating in the Advanced Computational Research Experience for Undergraduates (ACRES-REU).
- Met with students weekly, provided guidance on their research, and answered their questions as needed.

#### AWARDS

- MSU Graduate Office Fellowship (\$5400) October 2021
- Student Travel Award - SIAM DS21 May 2021
- MSU Graduate Office Fellowship (\$5000) February 2020
- Sabanci Foundation Scholarship October 2013 - June 2018

#### TECHNICAL STRENGTHS

**Programming:** Python, MATLAB, Julia, C/C++, OpenMP, MPI, SQL

**Software & Tools:** High Performance Computing, Sphinx, L<sup>A</sup>T<sub>E</sub>X, Solidworks, Inkscape