



Cyprus
University of
Technology

Department of Electrical
Engineering and Computer
Engineering and Informatics

Bachelor's Thesis

**Machine Learning-Based Classification of Fiber Specklegram Images
for Pressure Point Detection**

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Limassol, May 2025



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**MACHINE LEARNING-BASED CLASSIFICATION OF
FIBER SPECKLEGRAM IMAGES FOR PRESSURE POINT
DETECTION**

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The approval of the thesis by the Department of Faculty of Engineering and Technology does not imply necessarily the approval by the Department of the views of the writer.

I would like to express my deepest gratitude to my mother for her unconditional support and strength throughout my university journey. Her dedication, encouragement, and resilience, especially following the loss of my father, have been my guiding light. To my father, whose memory continues to inspire me each day: though you are no longer here, your love and values endure in every achievement. This work is dedicated to both of you.

ABSTRACT

In this paper, we demonstrate a method for determining the pressure applied to an optical fiber by analyzing its specklegram images using a neural network pipeline. In two steps, we fine-tune EfficientNetB0: first, we train a small classifier on top of frozen layers, and then we gently update the entire network with a decaying learning rate to produce stable 256-element feature vectors. During training, we employ RandAugment, CutMix, and MixUp to expand and diversify our data. These feature vectors are then fed into an XGBoost ensemble, and we combine its output with the CNN's softmax scores. On a hold-out test set of specklegrams, this hybrid model achieves an accuracy of over 94% and demonstrates balanced performance across all pressure classes. Our method is efficient and is running quickly on an A100 GPU. Future work could extend this approach to predict exact force values using regression models trained on more detailed datasets.