

UNIVERSITY OF SOUTH FLORIDA

Defense of a Doctoral Dissertation

Insect Classification and Explainability from Image Data via Deep Learning Techniques

by

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For the Ph.D. degree in Computer Science and Engineering

This dissertation is singularly concerned with designing, deploying and validating computer vision algorithms (a branch of AI dealing with image data sets) for addressing a range of problems in insect classifications. Our first problem is to design computer vision techniques to identify bees from image datasets. We specifically focus on bumble bees, and furthermore investigate how mimicry among insects can fool state of the art computer vision techniques. Next, we design computer vision algorithms to detect an endangered bee called the rusty-patched bumble bee from image data, and demonstrate the power of a novel anatomically inspired learning approach to improve both classification accuracy and explainability. Then, we present our design of algorithms to classify one of the deadliest mosquitoes today in nature – namely, *Anopheles stephensi* at the larval stage also via anatomically inspired learning. We briefly present our work on integrating our AI models in the cloud for widespread public use. Finally, while the core work in the domain of computing technologies, the broader impact of this dissertation spans agriculture, understanding species evolution and public health.

Examining Committee

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Tuesday, April 25th, 2023

9:00am ET

Online ([Teams](#))

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THE PUBLIC IS INVITED

Publications

- 1) Tanvir Bhuiyan, Ryan Carney and Sriram Chellappan, *Artificial intelligence versus natural selection: Using computer vision techniques to classify bees and bee mimics*, iScience, Volume 25, Issue 9, 16 September 2022.
- 2) Tanvir Bhuiyan, Ryan Carney and Sriram Chellappan, *Computer vision techniques for anatomically inspired classification of the endangered rusty-patched bumble bee (*Bombus affinis*)*, submitted to Scientific Reports
- 3) Mona Minakshi, Pratoool Bharti, Tanvir Bhuiyan, Sherzod Kariev and Sriram Chellappan, *A Framework based on Deep Neural Networks to Extract Anatomy of Mosquitoes from Images*, in 10/13059, Scientific Reports (2020).
- 4) Sriram Chellappan, Balaji Padmanabhan, Tanvir Hossain Bhuiyan, Arup Kanti Dey, Shaminur Rahman, *Methods and systems of authenticating of personal communications*, US Patent, US11451538B2.
- 5) Mona Minakshi, Tanvir Bhuiyan, et. al. , “Highaccuracy detection of malaria mosquito habitats using drone-based multispectral imagery and Artificial Intelligence (AI) algorithms in an agro-village in Unyama SubCounty, Gulu District, Northern Uganda”, in Public Health and Epidemiology, Vol 12/3, July 2020.

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