

May 20th, 12:30 PM

# Detection of Diabetic Foot Ulcers Using SVM Based Classification

Lei Wang

Worcester Polytechnic Institute, lwang1@wpi.edu

Peder C. Pedersen

Worcester Polytechnic Institute, pedersen@ece.wpi.edu

Diane M. Strong

Worcester Polytechnic Institute

*See next page for additional authors*

Follow this and additional works at: [http://escholarship.umassmed.edu/cts\\_retreat](http://escholarship.umassmed.edu/cts_retreat)

 Part of the [Artificial Intelligence and Robotics Commons](#), [Diagnosis Commons](#), [Endocrinology, Diabetes, and Metabolism Commons](#), [Skin and Connective Tissue Diseases Commons](#), [Theory and Algorithms Commons](#), and the [Translational Medical Research Commons](#)

---

Lei Wang, Peder C. Pedersen, Diane M. Strong, Bengisu Tulu, Emmanuel O. Agu, Qian He, Ronald A. Ignatz, Raymond M. Dunn, David M. Harlan, and Sherry L. Pagoto, "Detection of Diabetic Foot Ulcers Using SVM Based Classification" (May 20, 2014). *UMass Center for Clinical and Translational Science Research Retreat*. Paper 104.  
[http://escholarship.umassmed.edu/cts\\_retreat/2014/posters/104](http://escholarship.umassmed.edu/cts_retreat/2014/posters/104)

This material is brought to you by eScholarship@UMMS. It has been accepted for inclusion in UMass Center for Clinical and Translational Science Research Retreat by an authorized administrator of eScholarship@UMMS. For more information, please contact [Lisa.Palmer@umassmed.edu](mailto:Lisa.Palmer@umassmed.edu).

---

**Presenter Information**

Lei Wang, Peder C. Pedersen, Diane M. Strong, Bengisu Tulu, Emmanuel O. Agu, Qian He, Ronald A. Ignatz, Raymond M. Dunn, David M. Harlan, and Sherry L. Pagoto

**Comments**

Abstract of poster presented at the 2014 UMass Center for Clinical and Translational Science Research Retreat, held on May 20, 2014 at the University of Massachusetts Medical School, Worcester, Mass.

**Creative Commons License**

This work is licensed under a [Creative Commons Attribution-Noncommercial-Share Alike 3.0 License](https://creativecommons.org/licenses/by-nc-sa/3.0/).

**Title:**

Detection of diabetic foot ulcers using SVM based classification

**Full name of all Authors:**

Lei Wang<sup>a</sup>, Peder C. Pedersen<sup>a</sup>, Diane M. Strong<sup>b</sup>, Bengisu Tulu<sup>b</sup>, Emmanuel Agu<sup>c</sup>, Qian He<sup>c</sup>, Ronald Ignatz<sup>d</sup>, Raymond Dunn<sup>d</sup>, David Harlan<sup>e</sup>, Sherry Pagoto<sup>e</sup>

**Institutional affiliations:**

<sup>a</sup>Dept. of Electrical and Computer Engineering, Healthcare Delivery Institute at WPI; <sup>b</sup>School of Business, Healthcare Delivery Institute at WPI; <sup>c</sup>Dept. of Computer Science, Healthcare Delivery Institute at WPI; <sup>d</sup>Dept. of Surgery, University of Massachusetts Medical School; <sup>e</sup>Dept. of Medicine, University of Massachusetts Medical School

**Contact information:**

Lei Wang, [lwang1@wpi.edu](mailto:lwang1@wpi.edu), Peder Pedersen [pedersen@ece.wpi.edu](mailto:pedersen@ece.wpi.edu)

**Abstract:**

Diabetic foot ulcers represent a significant health issue, for both patients' quality of life and healthcare system costs. Currently, wound care is mainly based on visual assessment of wound size, which suffers from lack of accuracy and consistency. Hence, a more quantitative and computer-based method is needed. Supervised machine learning based object recognition is an attractive option, using training sample images with boundaries labeled by experienced clinicians.

We use forty sample images collected from the UMASS Wound Clinic by tracking 8 subjects over 6 months with a smartphone camera. To maintain a consistent imaging environment and facilitate the capture process for patients with limited mobility, an image capture box was designed with two right angled front surface mirrors and LED lighting.

We developed a novel foot ulcer recognition system using these sample images as our test data. Instead of operating at the pixel level, we use super-pixels, resulting from the quick shift algorithm, as the basic processing units. Then a support vector machine (SVM) based classifier is trained on the Bag-of-Words histogram representation of local Scale-Invariant Feature Transform (SIFT) features found in each super-pixel. As this classifier is very specific and the resulting histogram is very sparse, we merge the histograms from super-pixels in a size-specified neighborhood into one instance. Finally, to recover more precise boundaries of the foot ulcers, we apply conditional random field techniques to introduce new constraints that allow us to reduce misclassifications that occur near the edges of objects.

Experimental results show that our method provides promising recognition results, outperforming the regular SVM-based classification as well as the sliding window based object recognition method when evaluated using the Matthew correlation coefficient (MCC). We are integrating these algorithms into the wound assessment module of our Android phone-based diabetic self-management app.