Fire Technology manuscript No.
(will be inserted by the editor)

Wildland Fire Spread Modeling Using Convolutional Neural Networks

Jonathan L. Hodges · Brian Y. Lattimer

Received: date / Accepted: date

Abstract This paper presents a novel predictive analytics approach to estimating the spread of a wildland fire using a convolutional neural network (CNN). Simulated burn maps for use in this process were generated at six hour intervals using the phenomological fire spread model of Rothermel with 10,000 different combinations of input parameters. The robustness of the approach is tested using 1,000 simulations not included when training the CNN. Overall the predicted burn maps from the CNN-based approach agreed with simulation results, with mean precision, sensitivity, and F-measure of 0.97, 0.92, and 0.93, respectively. Noise in the input parameters was found to not significantly impact the CNN-based predictions. The computational cost of the method was found to be comparable to a phenomological model in homogenous spatial conditions, and significantly better for heterogenous spatial conditions. Although trained on predictions six hours apart, the CNN-based approach is shown to be capable of predicting burn maps further in the future by recursively using previous predictions as inputs to the model. When the initial fire was small, the model tended to under-predict fire spread; however, predictions generally improved as the fire grew.

Keywords Wildland Fire · Machine Learning · Neural Network · Fire Spread · Convolutional Neural Network · CNN

J. L. Hodges
Jensen Hughes
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060 USA
Tel.: +1 540-808-2800 x10611
E-mail: jhodges@jensenhughes.com