Developing a Deep Learning Model to Approximate the Convolutional Geometry of Wildfires

Huntley, Gene (School: Academy for Technology and the Classics)

With rapidly increasing global temperatures, fires have increased dramatically in both magnitude and number. Such fires can prove disastrous to the general population; in California, for example, wildfires have taken the lives of many and incurred billions of property damage. Thus, many researchers and insurance companies developed advanced mathematical and computational methods to mitigate the spread of said fires. However, their models have many limitations that have not been addressed; in New Mexico, according to the Santa Fe Fire Department, their antiquated wildfire model heavily underestimated the reach of wildfires. The many sophisticated computational models do have a level of inaccuracy still present; although they do predict the spread of a wildfire with an incredible level of accuracy, they fail to take into account variables past fuel, topography, weather conditions, and fire shape. A disproportionate amount of models also rely heavily on physics, which like the aforementioned computational models, fail to account for factors such as local fire department funding. Unlike the previous models, this study proposes a potential model that takes the following factors into account: weather, fuel, topography, and fire department competency and distance. Essentially, when given a 223-dimensional matrix similar to an image, the model returns a probability matrix of identical size, indicating where the fire could spread. The developed model can effectively predict the shape and size of a fire based on the given inputs. The model could not only save a substantial amount in damages, but also prompts further research on integrating non-physical factors into existing models.