

# OFFICIAL ABSTRACT and CERTIFICATION

## USING BOX-COUNTING DIMENSION TO CHARACTERIZE DIFFERENT STAGES OF DIABETIC RETINOPATHY

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The box-counting method was used to analyze the retinas of the progressive stages of diabetic retinopathy, a disease affecting the blood vessels of diabetes patients. It is characterized by the presence microaneurysms, hard and soft exudates, and hemorrhages, in order of increasing severity, and is considered proliferative when neovascularization (new vessel growth) occurs. The box-counting method is a tool used to quantify the complexities, or dimensions, of self-similar patterns. It was hypothesized that there's a significant difference between the dimensions of retinal vessels affected by diabetic retinopathy and the control group. In addition, it was hypothesized that there's a significant increase between the dimensions of the neovascularization stages and the non- proliferative stages.

130 fundus images from the DIARETDB0 database were divided into five groups: one control group and four stages of the disease, with the first two being non-proliferative and the final two being proliferative. Select images were processed using ImageJ to isolate the vessel patterns. The box-counting method was applied over 14 magnifications using the program FracLac and the mean dimensions of each group were recorded. The results were compared using t-tests and ANOVA. There was no significant difference between the box-counting dimensions of the four stages of diabetic retinopathy compared to the control and with each other. However, there was a significant increase in the dimensions between vessels exhibiting neovascularization and those that were non-proliferative ( $p = 0.0399$ ). Further research may involve completing more trials to increase accuracy; another parameter known as lacunarity may also be measured.

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