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Higuchi's fractal dimension in plant histology

PP1-2

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Fractals are self-similar patterns, from exactly the same to nearly the same, and hence they are common in Nature. Fractal analysis of digital images or signals already has the application in the assessment of properties of tumors, viral infections, blood vessels, neurons, EEG signals, heart rate variability, etc. In different fields of science, especially in botany, application of different fractal methods is necessary to obtain a complete picture of structures or processes.

We suggest a new method for 2D Higuchi's fractal dimension estimation for use in plant analytical microscopy. To present its performance, we used two different sets of digital microscopic images: light microscopy micrographs collected during *Tacitus bellus* direct shoot organogenesis from leaf explants *in vitro*, and confocal laser scanning microscopy images of stem cross sections of juvenile *Picea omorika* trees exposed to static bending stress. Estimated Higuchi's fractal dimension of presented sets of micrographs enables quantification, separation and alignment of subsequent morphogenic stages of shoot organogenesis on the time scale, i.e. quantitative gradation of structural changes of wood cell properties on a compression severity scale, respectively.

Suggested fractal analysis method, combined with statistical analysis, could be used for quantification of structure complexity that characterizes cells and tissues during different growth and developmental processes or stress related structural changes in plants, as well as for the evaluation of the synchronization of those processes. It allows fast computational analysis of micrographs and is independent of the type of microscopy used.

Keywords: 2D Higuchi fractal analysis, shoot organogenesis, compression wood.

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