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Simulation of stromatolite growth using diffusion limited aggregation: model and software

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Stromatolites are complex systems whose understanding requires knowledge from various scientific fields, e.g. geology, biology, and chemistry. Modelling such phenomena is not an easy task, as it cannot be easily described either by simple mathematical equations, or by simple physical laws or chemical reactions. Therefore, a holistic approach is a good solution to simulate the growth of such complex systems. Such an approach, able to simulate stromatolite growth, can be based on diffusion limited aggregation (DLA), leading to a simplified yet powerful model. The model includes three main parameters described as (i) particle input in the system, (ii) attraction distance to the cluster (stromatolite build-up), and (iii) stability distance (stromatolite lateral propagation). These three parameters are analogues of stromatolite growth rate, branching capabilities, and stromatolite community diffusion. Simulation results display virtual morphologies similar to real world stromatolites. Sedimentation has been added as a constraint during growth. Its impact on stromatolite shapes leads to results which can be accurately compared with natural morphologies. It also demonstrates that, set with the same simulation parameters, the influence of sedimentation allows the generation of various morphologies, questioning the pertinence of classifications based only on stromatolite macroscopic shapes. To run this model, two softwares have been developed in C++ for maximum flexibility and performance. The first software allows simulations to be run and set and results to be saved in files. The second software is used to open those files and display results in three dimensions, with various visualization options (rotation, slices, colour map, zoom).