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Towards an Automatic Recognition of DNA Nanostructures on AFM images

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With the technology of Atomic Force Microscope (AFM), we can directly observe DNA nanostructures in high resolution. An AFM image of DNA nanostructures contains a variety of shapes including single DNA nanostructures, overlapped DNA nanostructures and a lot of noise shapes. Automatic recognition and classification of DNA nanostructures are strongly demanded to reduce human efforts in AFM image analysis.

In this research, automatic-recognition of single DNA nanostructures in AFM images based on the information of their outer contours has been proved. The information about the outer contour of a DNA nanostructure includes not only peak points in the curvature scale space (CSS) images, but also the convexity-concavity of the outer contour. Our prototype system of DNA nanostructure recognition demonstrates that the CSS information is effective for the classification of open and closed forms of DNA origami pliers [1,2].

The prototype system is developed on robot technology middleware (OpenRTM-aist) [3] to integrate multiple components written in different languages running on multiple operating systems such as linux and windows. The prototype system currently consists of two components named “GetNanoDNASize” and “RecognizeNanoDNA”. The former component is a preprocessing system for picking DNA nanostructures in AFM image focusing on the lengths and areas of DNA nanostructures. The latter component classifies DNA nanostructures based on CSS and convexity-concavity information as well as the lengths and the areas of DNA nanostructures.

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