Image Analysis of Single DNA Molecules

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The duplication of genetic information (DNA replication) is central to life. Numerous control mechanisms ensure the exact course of the process during each cell division. Disturbances of DNA replication have severe consequences for the affected cell, and current models link them to cancer development. One of the most accurate methods for studying DNA replication is labeling newly synthesized DNA molecules with halogenated nucleotides, followed by immunofluorescence and microscopy detection, known as DNA fiber labeling. The method allows the registration of the activity of single replication complexes by measuring the length of the "trace" left by each of them. The major difficulty of the method is the labor-intensive analysis, which requires measuring the lengths of a large number of labeled fragments. Recently, the interest in this kind of image analysis has grown rapidly. In this project we have developed an algorithm and a lightweight Java application to automatically analyze single DNA molecule images that we have named "DNA size finder". DNA size finder significantly simplified the analysis of the experimental data while increasing reliability by the standardized measurement of a greater number of DNA molecules. It is freely available and does not require any paid platforms or services to be used. We hope that the application will facilitate both the study of DNA replication control and the effects of various compounds used in human activity on the process of DNA replication.