MATHEMATICAL ANALYSIS OF EQUATION IMITATING DNA BASE OSCILLATIONS

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It is widely accepted that DNA is one of the most important biological molecules because of its ability to storage and transfer genetic information. It is known already that the DNA structure is no static, but dynamic (some scientists say, that 'DNA breaths'), and that studying that dynamics helps us to understand better the dynamical mechanism of biological activity of the molecule.

In this work only one aspect of the DNA dynamics is considered, namely, the rotational oscillations of DNA bases around the sugar-phosphate chains. We consider in details one base's oscillations, and to study those oscillations, we use the analogy between rotational oscillations of a DNA base (adenine thymine, guanine or cytosine) and oscillations of a single mechanical pendulum [1].

The work contains equation, simulating those oscillations and transformation of it to the form:

$$\varphi_{\tau\tau} + \sin\varphi = -b_0\varphi_\tau + k_0$$

convenient for mathematical analysis. Using the values of the DNA parameters taken from [2] we estimated the coefficients k_0 and b_0 and constructed the phase portraits (made in Maple) for each of the DNA bases. We found differences in the phase portraits and discussed possible relation of them with functional properties of the DNA molecule.

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References

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