Braid Theory and Classification of Periodic Orbits of the Three-Body Problem

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It is known that each periodic orbit can be assigned to a spatial braid. The goal of the project is to check the hypothesis on the possibility of applying the braid theory to the classification of periodic orbits of the three-body problem. The three-body problem is described by a non-integrable system of differential equations and has complicated dynamics which can be partially understood by studying periodic solutions of this problem. Classification of periodic solutions is to find out whether it belongs to some family or to define for a given orbit its "generating" one. There are many scientific space projects which need for periodic orbits with predetermined properties, therefore classification of periodic orbits can simplify solving this problem. Developed algorithms that provide numerical data to build a spatial braid and to compute its braid formula. The analysis revealed that the orbits visually having similar properties have the same fragments in the braid formulas. The study showed that the mathematical braid theory is applicable to the classification of the periodic orbits of the three-body problem. The repeated fragment of the formula allows us to determine the “generating” orbit of the family, that is, its simplest orbit. The empirical hypothesis about the origin of specific orbits from the "figure of eight" orbit was confirmed, since all these orbits had a fragment of the formula, which is the formula of the "figure of eight" orbit.

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