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LIE-SERIES SOLUTION OF THE MODIFIED CIRCULAR RESTRICTED THREE-BODY PROBLEM (CR3BP)

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Abstract. In this paper, the method of Lie-series is used to construct the solutions for the modified circular restricted three-body problem (CR3BP) with the impact of radiation pressure, albedo effect, and oblateness. We have considered that the larger primary is a radiating primary, whereas the smaller primary generates the albedo effect. Moreover, the smaller primary is also considered as an oblate body. To apply this Lie-series technique, we have reduced the system of second order ordinary differential equations to first order ordinary differential equations. Subsequently, a series of recurrence relations are derived in the Lie-series solution of the considered model, facilitating a rapid and successive computation of any required number of terms. The applicability of the Lie-series solution is illustrated by analyzing the Sun–Earth and Sun–Jupiter systems.

Keywords. Radiation pressure, Oblateness, Albedo effect, CR3BP, Lie-series solution.

AMS (MOS) subject classification: 70F15, 70F07.

1 Introduction

The three-body problem is a complex dynamical system characterized by its mathematical depth and real-world applications. A fundamental problem in celestial mechanics, the generalised three-body problem seeks to determine, movements of the three masses in space influenced by their mutual gravitational forces. Exploring the three-body problem offers two main advantages: the findings from these studies often have wider relevance in the context of dynamical systems theory, and the research itself is clearly tailored to tackle problems in Astronomy [1, 2, 3, 4, 5, 6].

There has also been a lot of research over the last few years on whether or not the three-body problem has periodic solutions and on what their nature may be. In [7], the authors interpreted that the circular restricted three-body problem (CR3BP) does not possess any non-trivial solutions that are