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Lyapunov Exponent Criterion in the CR3BP BILLY QUARLES, JASON EBERLE, MANFRED CUNTZ, ZDZISLAW MUSIELAK, UT Arlington
— Our specific focus is to describe the motion of an extra solar planet in a binary star system. We aim to accomplish this by using the methods of chaos theory as an alternate method to our previously established Hodograph method in the circular restricted 3-body problem (CR3BP). Previously Eberle et al. (2010) has shown that a parameter space exists depending only on the mass ratio μ and distance ratio ρ_o which allowed them to identify regions of stability. Our method will validate the previous results while also providing more information relating to the presence of resonances and their effects on orbital stability. We extend the previous studies by increasing the simulation time, applying the method of Lyapunov exponents, calculating the time series spectrum of the orbit, and determining the Lyapunov dimension. The obtained results demonstrate when a system becomes unstable by orbital energy criterion and the method of Lyapunov exponents provides a quantitative classification scale to characterize the instability. By applying the maximum Lyapunov exponent (MLE) to the parameter space, we determine a region of stability with MLE values larger than the surrounding region. The time series spectra and the Lyapunov Dimension methods are used to illustrate the reasons behind the stability plateau which eludes to the resonance phenomena.

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