Boundary curves in the weak stability transition-region

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The weak capture represents the event where the Keplerian energy of the massless particle relative to one of the primaries changes its sign from positive to negative in the context of the restricted three-body problem. Belbruno (1987) introduced the notion of weak stability boundary (WSB) by designing transfer orbits from Earth to Moon. In this paper Belbruno also proposed an algorithmic definition of the WSB, where the initial conditions are classified to be stable or unstable according to weak stability criteria.

In the articles dedicated to the study of WSB, certain parameters (for example, the true anomaly of Earth, Moon or another planets, the initial eccentricity of the test particle, the initial direction of the test particle) are considered constant and the initial position $\mathbf{r}_2$ of the test particle relative to the primary P_2 is considered a variable parameter. The modulus of initial velocity $\mathbf{v}_2(\mathbf{r}_2)$ of the massles particle relative to the primary P_2 is determined, and then the weak stability of the orbit with the initial values $(\mathbf{r}_2, \mathbf{v}_2(\mathbf{r}_2))$ is examined. In these cases, the independent variable is $\mathbf{r}_2$ and the dependent variable is $\mathbf{v}_2$.

In this lecture, the velocity $\mathbf{v}_2(\mathbf{r}_2)$ is also considered as an independent variable in the study of weak stability. Four boundary curves are defined in the weak stability transition-region (WSTR). As an application, the boundary curves of WSTR are numerically determined in the Sun-Earth system. The locations of the boundary curves are compared to the Earth-Moon mean distance.

References

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