Optimal Deflection of Earth-Crossing Asteroids Using Laser Energy

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There are space collision events like the Shoemaker-Levy9 comet with Jupiter in July 1994, as well as about 100 terrestrial impact craters. In this study, a continuous optimization problem is formulated to calculate the optimal laser energy for deflecting Earth-Crossing Asteroids(ECAs). The direct collocation technique is used for adopting a nonlinear programing. The continuous laser energy is provided to change the ECA's velocity for avoiding impact to the Earth. The nonlinear constraints of the optimization problem are based on the Hermite-Simpson's equations and the three-dimensional patched conic approximation including the Earth's gravitational effects. The optimal duration of lasing 0.1~1.0 km-class ECAs is estimated for various deflecting scenarios. The analysis performed in present paper can be practically applied to deflection missions by using spacecraft with limited power.