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MISSION ANALYSIS FOR TWO POTENTIAL ASTEROIDS THREAT SCENARIOS: OPTIMAL IMPACT STRATEGIES AND TECHNOLOGY EVALUATION

Abstract

The Space Mission Planning Advisory Group (SMPAG) is a United Nation mandated group, constituted in 2014 following the recommendation of the working group on Near-Earth Objects (NEOs) and Technical Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space. In strong synergy with the International Asteroid Warning Network (IAWN), SMPAG's mission is to prepare for an international response to a NEO impact threat through the exchange of information, development of options for collaborative research and mission opportunities, and to conduct NEO impact threat mitigation planning activities. The Italian Space Agency (ASI) is a member of SMPAG and contributes to the Group's activities by identifying reference missions for different NEO-threat scenarios and carrying out Phase 0 studies. As result of the performed activity, this paper proposes two reference missions in response to potential threat by different typologies of asteroids. The analysis of these two scenarios will allow to provide the most effective response in case of a real NEO-threat (as confirmed by IWAN). Two target scenarios for an asteroid deflection mission were identified on the basis of the following criteria: (i) "Small-size" asteroid of 22MAG corresponding to a diameter of 70 - 100m, direct impact trajectory, lead time to impact of about 10years; (ii) "Large-size" asteroid 17MAG corresponding to a diameter of 500m - 1 km, resonant encounter trajectory, lead time to the impact of about 20years. In both cases the asteroid 2010RF12 was chosen as a representative target, as currently it has the highest probability of hitting the Earth. As this asteroid's diameter is only between 4 m and 12 m, its orbit was used in this study, while its size was increased to create a synthetic object. Indeed, 2010RF12's orbit will lead to either an impact the Earth, or a very close encounter with it, at the end of the current century. For each case, the deflection strategy of the NEO's impacting trajectory is selected by means of an optimisation procedure to minimise the spacecraft launch mass, while maximising the asteroid miss distance. The effects of uncertainties in

the deflection manoeuvre and the asteroid's response to the deflection action are taken into account. To get significant advances in the verification of the technical feasibility of the deflection strategy identified, the analysis will define all the mission components, from the launcher identification to the design of the spacecraft system and subsystems (e.g. propulsion, power management, GNC etc.).