Review of: "ALR_Sim_tracks - trajectory simulator software to assist the search for favourable trajectories for the exploration of the triple Asteroid 2001-SN263 from the Laser Altimeter point of view"

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Potential competing interests: No potential competing interests to declare.

The paper presents the software ALR_Sim_tracks which simulates trajectories based on geometric considerations and also evaluates externally generated trajectories (obtained based on dynamics). The software is useful and contributes to the field of planetary exploration. However, some features of the paper require additional clarity to help readers understand the software, as outlined below:

Clarity of the methodology

- The paper does not describe the simulation methodology. Only inputs and quality evaluation criteria are described. While reading the paper, I assumed that the methodology is the same as that given in references [5] and [6]. Even then some details need to be elaborated, for e.g., the flowchart mentions “solve non linear system”. Which equations are being referred to? The module **simulate_trajectory.m** seems to be the main script producing the results. The authors should ellaborate more on what this module does and how it simulates the trajectories.
- The tracks simulated by the software are presented with reference to the main asteroid and does not show the full path from Earth to the target. For some of the figures (e.g. figure 4(d)) the author should show the full track along with the position of the Sun and the Earth. Moreover, regarding 4(d), the caption says it is in the Heliocentric system. If so, shouldn’t the Sun be at the origin (0,0,0) of the plot?
- Why are two different flowcharts (Fig 1 and 2) shown for the simulator although the only difference between the two is in terms of the type of trajectory? To show that the software can be generalized to other cases, the author should combine the two flowcharts allowing the flexibilities as a separate input or a selectable parameter. Otherwise the simulator seems to be very specific to the cases reported.
- It is stated that *“For validation purposes, a comparison of the results obtained using this approach with the traditional one, which uses trajectories generated by integrating the relevant dynamics involved, was carried out and is discussed in reference [5]”* and “*However, internally simulated orbits (Fig. 4c, 4d), using characterisation parameters obtained in [10], were also studied and produced similar results.*” It is not clear if the stability checks and the comparisons of the trajectory with methods based on dynamics has been done only in case of the results presented in the paper or these routines are part of the software? I think it should be done for every simulation, otherwise the tracks simulated for a favourable geometry may not be practically feasible to obtain from dynamics point of view. The author could present

the results (or produce it as output of the software) on the stability of the internally simulated orbits to be convince the readers (and future users of the software) of the validity of the simulated tracks.

- For the results reported in the paper, some of the specific inputs have not been provided, such as the instrument parameters, the encounter period etc.

Additional information regarding the simulated trajectories is needed to understand the practical feasibility of achieving them. These include the possible launch window (especially if using a gravity assisted trajectory), the launch vehicle to be used, the maximum allowable excess velocities, propellent requirement, the total mission life, cruise time and the constraints on the spacecraft (such as weight, volume, total area of the solar panels). The solar panels will decide the energy available for downlinking the data, thus affecting the data rate and data volume. The instrument PRF will be constrained by the data rate available. Therefore I highly recommend the author to consider these factors either as inputs or to report them in association with the simulated results.

In [5], "The shape of the s/c was set to a cube with a surface area of 6 x 0.25 sqm. Additionally, a solar panel area of 20 sq.m and a s/c mass of 400 kg were assumed." if there are changes in these parameters, is the software capable of generating new trajectories that are will be physically meaningful with the new parameters?

Mission designs can benefit from a trade-off analysis provided by simulation softwares. As mentioned in [5], "a compromise between the number of impulses and the positional accuracy must be found." if the number of impulses are not hard-coded, it would allow testing different impulse frequencies and choose the right one based on achievable accuracy.

Capability of generalizing the software to other missions, instruments and targets

It is stated that the software can be used for other optical equipments (*which have a central line of sight and operate sufficiently close to the target, aiming to cover its entire surface area using sequential individual images or pulse shots),* in a different period of interest and for a different target. I think the method can not only be easily adapted to optical instruments but to any remote sensing instrument as long as its acquisition geometry can be clearly defined mathematically. It will be sufficient to define the **read_instrument parameters.m** and the calculations of the evaluation metrics would require minor modifications. Thus, the instrument is not the main factor effecting the generalization of the software. On the other hand, it is not clear how the software extended to the following different scenarios:

- the size of the target body (for e.g. will it work for the gas giants, their moons, other planets)
- type of trajectory: the paper shows two types of trajectories - encounter and terminator described in detail in [5] and [6]. Does it work for other types of trajectories like flybys, orbits around planets? Is it possible to simulate different trajectories starting from Earth to the asteroid, such as ballistic or low-thrust gravity assist trajectories? Or does the software only simulate two of the trajectories, while any other trajectory should be externally generated and the software can only be used for testing them? If so, this should be clearly stated.
- duration of the campaign: the results are all presented for a 1-month campaign. If the duration is to be increased, it can increase complexity of the simulations, even considering data downlinking requirements. What is the maximum

duration of campaign for which the software can simulate realistic trajectories?

- quality metrics: is it possible to provide a different set of quality metrics such as the horizontal resolution, to make the plots? Can these be user defined?
- geometric considerations: Can the software be used with different geometric parameters besides the orbit inclination, the target-spacecraft distance and the relative position?