CONSIDERATIONS FOR THE APPLICATION OF PROBES FOR MINERAL SAMPLING ON APOPHIS. P. A. Johnson [1,2], J.C. Johnson[1,2,3], and A. A. Mardon[1,2], [1] University of Alberta (email: paj1@ualberta.ca), [2]Antarctic Institute of Canada (103, 11919-82 Str. NW, Edmonton, Alberta CANADA T5B 2W4; email: aamardon@yahoo.ca), [3]Faculty of Engineering, University of Alberta (email: jcj2@ualberta.ca)

Our group has previously examined design considerations for motor units of space probes and unmanned aerial vehicles for use in Mars missions as well as on asteroids. We hereby extend these design considerations to its use for the 2029 99942 Apophis.

The considerations originally proposed in our model include: (i) power considerations, (ii) high climb and loiter speed, (iii) data-link bandwidth capabilities. (iv) navigation, (v) rotor use in gravitational fields, and (vi) emergency considerations including loss of contact with ground control. Of these space probe motor units for the Apophis must fulfill all capacities, however differences in gravitational field, asteroid spin and orbit potentially interfere with maneuverability and function of probes.

Having initially thought to pass through a gravitational keyhole suggesting a later impact in 2036 or 2037, there is still a level of uncertainty regarding the trajectory of the Apophis. As such, it is necessary for a refined and high precision trajectory calculation to be made prior to the launching of space probes. As of the most recent observations in 2015, there are lower impact estimates and the feasibility of calculating a higher precision trajectory in coming years is promising.

In addition, calibration to account for dipole torque differences and forces on motor units as well as an accounting of the expected frame dragging effect is necessary in light of high interference asteroid surface and orbit has also been identified previously.

The development of a space probe or several space probes may include multi-spectral imaging, near-infrared spectrometers, temperature probes, accelerometers, laser rangefinders, magnetometers, etc. These probes would enable the characterization and visualization of the interior structures, seismic activity, and dynamics of Apophis, thereby improving our generalizable knowledge about trajectories and impacts of asteroids as well as guide planning for future missions.

References: [1] Johnson J.C., Johnson P.A. & Mardon A.A. (2019) Design considerations to tailor unmanned aerial vehicles for martian geoclimatic condition. *American Research Journal of Humanities and Social Sciences*, 5(1), 1-2. [2] Johnson P.A., Johnson J.C., & Mardon A.A. *Asteroid Science in the Age of Hayabusa2 and OSIRIS-Rex*, Tucson AZ, Abstract# 2011.