

Mars Regolith Digger: A robotic system to autonomously excavate on Mars surface

Overview: In this work we envision the conceptual design, detailed study and miniaturized prototype realization of a robotic system capable of autonomous excavation of Mars regolith ground. Such a robotic system is to be designed to investigate new means for the future of autonomous preparation of a human base on Mars. Regolith will be used to develop the needed structural materials and thus its robotized excavation is essential. In this work the main focus is on the mechatronic design and control of this Mars Regolith Digger concept, while further study on its perception solution is also possible if time allows.



Image from the NASA Regolith Advanced Surface Systems Operations Robot (RASSOR). Found at: <https://nypost.com/2020/03/18/nasa-wants-your-help-designing-the-robot-that-will-go-digging-on-the-moon/>

****This is not work of our lab****

Tasks and sub-objectives:

- Literature review of robotic excavation systems and concepts for mars excavation
- Understanding of regolith properties and thus requirements for the Mars Regolith Digger
- Mars Regolith Digger conceptual designs, presentation and selection
- Mars Regolith Digger concept design simulation model
- Mars Regolith Digger concept design automated control for motion and excavation
- Mars Regolith Digger miniaturized robot development and evaluation (on Earth!)

Starting Literature

- [1] Mueller, R.P., Smith, J.D., Schuler, J.M., Nick, A.J., Gelino, N.J., Leucht, K.W., Townsend, I.I. and Dokos, A.G., 2016. Design of an excavation robot: regolith advanced surface systems operations robot (RASSOR) 2.0. In Earth and Space 2016: Engineering for Extreme Environments (pp. 163-174). Reston, VA: American Society of Civil Engineers.
- [2] Leucht, K.W., 2018. How NASA will use robots to create rocket fuel on Mars: The year is 2038. IEEE Spectrum, 55(11), pp.34-39.
- [3] Starr, S.O. and Muscatello, A.C., 2020. Mars in situ resource utilization: a review. Planetary and Space Science, 182, p.104824.
- [4] Mueller, R.P. and Van Susante, P.J., 2012. A review of extra-terrestrial mining robot concepts. Earth and Space 2012: Engineering, Science, Construction, and Operations in Challenging Environments, pp.295-314.
- [5] Thangavelautham, J., Chandra, A. and Jensen, E., 2020, March. Autonomous Robot Teams for Lunar Mining Base Construction and Operation. In 2020 IEEE Aerospace Conference (pp. 1-16). IEEE.