The mobile gantry architecture becomes even more valuable when considering military applications. Structures in forward operating areas must be built quickly, often under threat, with minimal existing infrastructure and support. The mobile gantry architecture requires fewer support personnel (reducing risk), is more easily transported (due to the ability to roll out of the transport container) and only requires site clearing and not extensive site preparation. These factors make the mobile gantry an ideal candidate for future 3D printing of military structures.

Applying this architecture in these areas will require continued advances in the coarse positioning, fine positioning, and localization subsystems as well as the integration of print heads that are relevant in terrestrial applications.

4 Conclusion

Mud Dauber is a prototype of the *mobile gantry architecture*. Robots of this architecture roll directly on the planetary surface but move back and forth as though on a set of virtual rails. These robots are simple to control, generate continuous print paths, and can build structures measuring 10's or even 100's of meters in length. A key new capability of this architecture is the ability to use the robot's printed structures as scaffolding upon which the robot can climb to print taller structures. This capability allows the printing of structures taller than the robots themselves. These capabilities open the door to the construction of complex and capable structures that are taller and longer than those generated by robots of competing architectures and similar size.

Mud Dauber is an early prototype of this architecture, designed to perform 3D printing of test structures while demonstrating key capabilities. This paper detailed the five major subsystems developed for the prototype and reported on early validation testing of these subsystems. Mud Dauber is a first step in the development of more capable 3D printers for construction on Earth, Mars and beyond.

4 Acknowledgement

This research was performed under funding from the Indiana Space Grant Consortium (INSGC) at Taylor University. Prototype development was performed as part of engineering design classes and as such was supported by a large team of undergraduate students. Special thanks to: H. Childs, J. Conejero, C. Deckard, N. Eshuis, C. Gardner, M. Jacques, K. King, C. Lehrian, L. Mason, J Meleski, N. Reisler, J. Richey, M. Shearer, N. Streitmatter, R. Cartwright, and S. Dalcher.

5 References

[1] "Meet Frank and his family" Apis Cor, 2022. Online: https://www.apis-cor.com/technology, Accessed: 2/20/2022

[2] "Architecture on Mars" AI Spacefactory, 2022. Online: https://www.aispacefactory.com/marsha

[3] Yuan X., Zhang J., Zahiri B., and Khoshnevis B. "Performance of Sulfur Concrete in Planetary Applications of Contour Crafting." Additive Manufacturing Conference, Jan. 2016.

[4] Howe A. S. *et al.* "Modular Additive Construction Using Native Materials." *Earth and Space 2014*, St. Louis, Missouri, Jun. 2015, pp. 301–312.

[5] Cesaretti G., Dini E., De Kestelier X., Colla V., and Pambaguian L. "Building components for an outpost on the Lunar soil by means of a novel 3D printing technology." *Acta Astronautica*, vol. 93, pp. 430–450, Jan. 2014.

[6] Khorramshahi M. R. and Mokhtari A. "Automatic Construction by Contour Crafting Technology." Emerg Sci J, vol. 1, no. 1, p. 28, Jul. 2017.

[7] "Meet ICON's next generation Vulcan construction system." https://www.iconbuild.com/vulcan Accessed: 4/24/2022

[8] Staritz P.J., Miller, C.S., and McClurg, J.C. "The Mobile Gantry: A Robotic Architecture for 3D Printing Structures on Mars" Available EngrXiv.org