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Option 2: Extended Abstract
3D Printed Joining System Inspired by Traditional Japanese Wooden Joinery for ISRU

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Extended Abstract

This research presents a joining system that changes an irregularly shaped material into a member that can be joined and disassembled as a single unit by attaching 3D printed joints. In extreme environments, including extraterrestrial environments, it takes much time and costs to supply materials from Earth. In addition, when living and working in such environments for long periods, a technology enabling the use of locally accessible materials or elements brought to the site for different purposes is essential to realize the construction based on the idea of In-Situ Resource Utilization (ISRU). This research proposes a joining system inspired by the traditional Japanese wooden joinery *Kigumi*. By integrating Kigumi's excellent features, such as high construction performance, disassemble performance, and mechanical performance, with 3D printing and 3D scanning technologies, the proposed joining system aims to enable irregular-shaped elements to be assembled and disassembled from one another without any fasteners (e.g., bolts, nails, and adhesive). Prototypes of the proposed joints, which apply the Japanese Koshikake-Ari-Tsugi technique, were printed by an additive manufacturing-type desktop 3D printer, then the investigation focused on determining the optimal clearance for the joint. Based on the results, a simple mockup was constructed. Its constructability and mechanical performance were examined. The findings revealed that the joints applying the traditional Japanese Kigumi were printable by the additive manufacturing-type desktop 3D-printer with proper clearance settings, and the proposed joining system shows high performance in construction, including disassembly. The findings provide insights into the feasibility of desktop 3D printing construction in extreme environments.

Key Words: In-Situ Resource Utilization, Kigumi, 3D Printing and Scanning, Additive Manufacturing, Extreme Environments