

# FrameFab: Robotic Fabrication of Frame Shapes

Ligang Liu, Professor

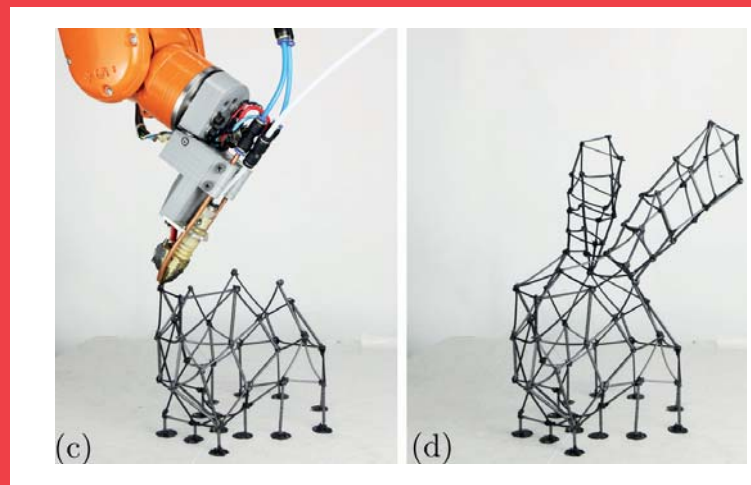
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Frame shapes, which are made of struts, have been widely used in many fields, such as art, sculpture, architecture and geometric modeling, etc. An interest in robotic fabrication of frame shapes via spatial thermoplastic extrusion has been increasingly growing in recent years. In this talk, we present a novel algorithm to generate a feasible fabrication sequence for general frame shapes. To solve this non-trivial combinatorial problem, we develop a divide-and-conquer strategy that first decomposes the input frame shape into stable layers via a constrained sparse optimization model. Then we search a feasible sequence for each layer via a local optimization method together with a backtracking strategy. The generated sequence guarantees that the already-printed part is in a stable equilibrium state at all stages of fabrication, and that the 3D printing extrusion head does not collide with the printed part during the fabrication. Our algorithm has been validated utilizing a prototype robotic fabrication system made of a 6-axis KUKA robotic arm with a customized extrusion head. Experimental results demonstrate the feasibility and applicability of our algorithm.



Ligang Liu is a professor at the School of Mathematical Sciences, University of Science and Technology of China. He received his Ph.D. (2001) from Zhejiang University, China. Between 2001 and 2004, he worked at Microsoft Research Asia. He paid an academic visit to Harvard University during 2009 and 2011. His research interests include digital geometric processing, computer graphics, and image processing. He serves as the associated editors for journals of IEEE Transactions on Visualization and Computer Graphics, IEEE Computer Graphics and Applications, Computer Graphics Forum, Computer Aided Geometric Design, and The Visual Computer. He served as the conference co-chair of GMP 2017 and the program co-chairs of GMP 2018, CAD/Graphics 2017, CVM 2016, SGP 2015, and SPM 2014. His research works could be found at his research website: <http://staff.ustc.edu.cn/~lgliu>