Data-Driven Discovery of Polymeric Material for 3D Printing

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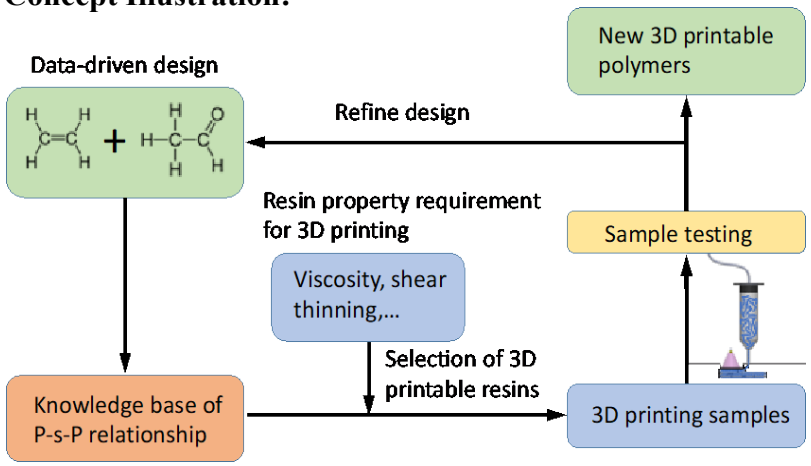
Objectives: Discover, develop, and validate new polymers with specific properties, such as glass transition temperature modulus, and toughness by using a data-driven approach in the design and selection of different monomers and 3D printing conditions so that these new polymer resins can be 3D printed with the desired properties of the end-product.

Technical Approach: This work will leverage the recent advances: (i) Application of data-driven methods for polymer designs with targeted properties to efficiently explore the discovery of new polymers. (ii) Deeper understanding of resin properties (such as viscosity) required for 3D printing. (iii) Development of highly integrated multimaterial 3D printing complemented by the robotic placement method and in-situ printing quality monitoring. Building upon these achievements, we propose to design and demonstrate a highly integrated approach where new polymers can be designed by using a data-driven approach and be 3D printed by using a proposed novel direct-ink-write (DIW) 3D printing method where different monomers can be supplied at precisely controlled ratios as instructed by the data-driven designs. The printed part will then be tested to verify the designs and the proposed integrated approach.

Concept Illustration:



Impact: One of the biggest hurdles in broad applications of additive manufacturing (3D printing) is the limited number of 3D printable material; this is particular worse for polymers as AM-able polymers are only a very small portion of currently widely used engineering polymers. The proposed work combines the achievement in data-science and the new AM methods and will greatly accelerate the development of new polymers that possess superior properties and can meet the requirement of engineering applications. In addition, the proposed approach will pave the road for the future development of functional polymers for 3D printing.