Adaptive modularized constructions made in a flux

Modular and prefabricated UHPC bridges

Grammar-based Design and trajectory-sensitive Additive Manufacturing

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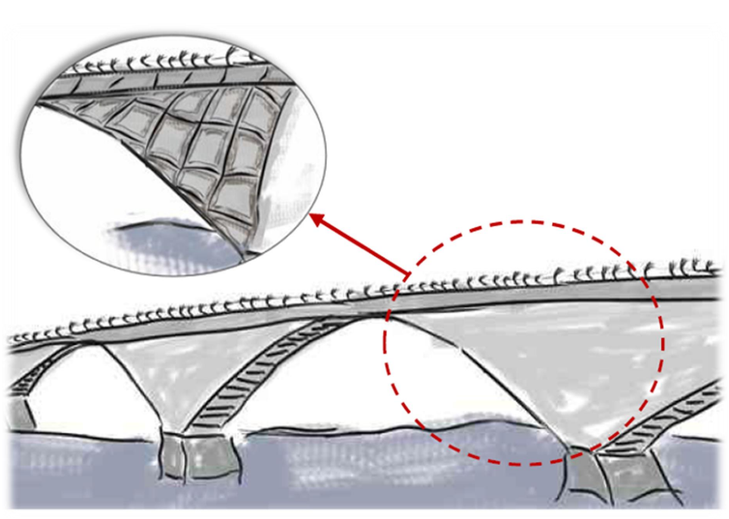
SPP 2187

Motivation

Design

Grammar-based Conceptual Design for networks of complex, parametric geometries

- Multi-objective driven top-down decomposition of girders
- Heuristic, generative bottom-up generative assembly

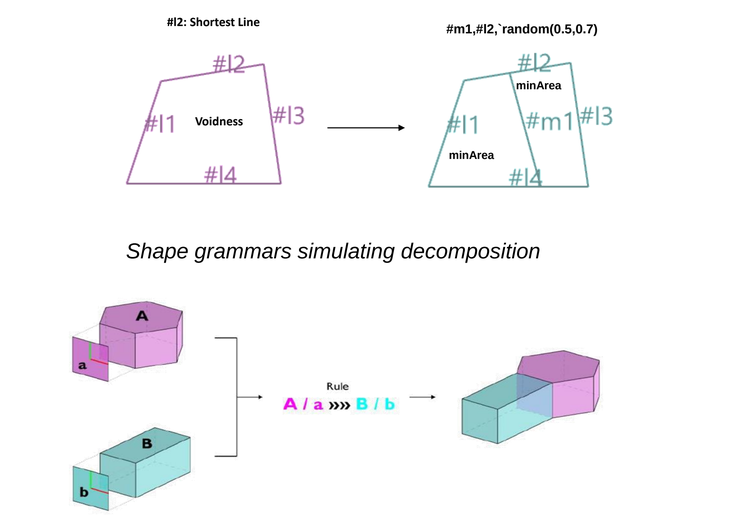


Manufacturing

Optimized structural design and production process for outstanding structural properties

- Principal stress trajectory oriented, homogenized path planning for optimal utilization of carbon fibres
- Manufacturing process geared towards efficiency and robustness

Methods

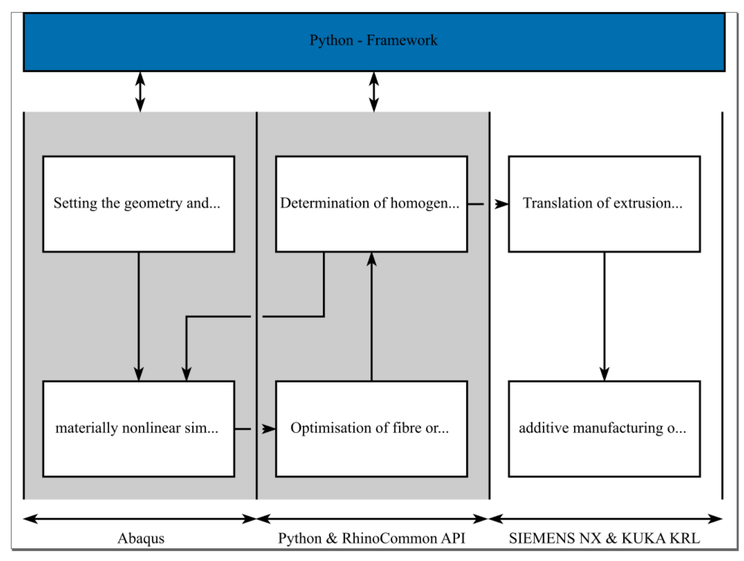


Shape grammars simulating decomposition

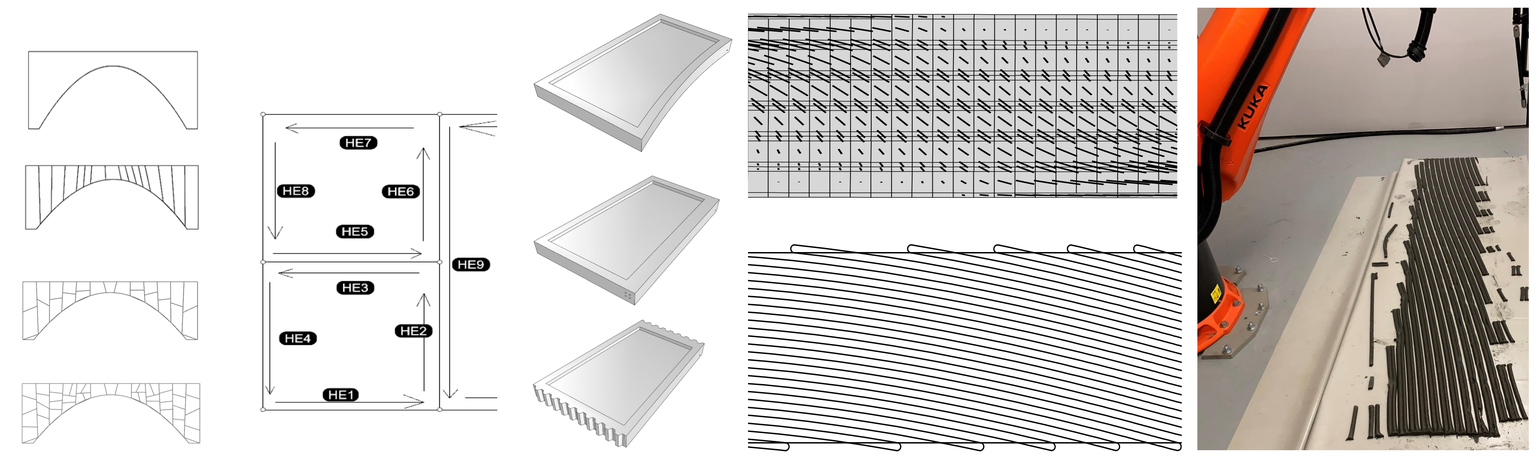
Graph grammars simulating assembly

Digital Design and Manufacturing

- Sophisticated digital process chain from development to production
- Development of Ultra high performance carbon short fiber reinforced concrete tailored towards application in 3D printing



Results



Shape Grammar → Graph Product Model → Parametric Geometry → Analysis-aware path generation → Manufacturing Experiments

Outlook

- Processing variable 3d bridge models with grammars
- Automated reasoning strategies for grammars
- Completly automated generation of printing paths respecting manufacturing boundaries

Publications

[1] AUER, D., FISCHER, O.: Trajektorienorientierte Konzeption und Herstellung effizienter Strukturen aus gedrucktem Carbonkurzfaserbeton. Proceedings 25. Münchener Massivbau Seminar, 2021.

[2] AUER, D, ,LAUFF, P., FISCHER, O.: Carbon Short Fibre Reinforced Concrete in Additive Manufacturing: Upscaling Process and Mechanical Properties. 3rd RILEM International Conference on Digital Fabrication with Concrete (Digital Concrete 2022) , 2022. [Submitted]

[3] AUER, D., FISCHER, O.: Homogenization of Principle Stress Trajectories for Use in Extrusion Based Additive Manufacturing. Additive Manufacturing, 2021. [in Preparation]

[4] KOLBECK, L., AUER. D, VILGERTSHOFER, S., FISCHER, O. BORRMANN, A.: Modulare Brückenbauwerke aus carbonfaserbewehrtem Ultrahochleistungsbeton. Beton- und Stahlbetonbau Sonderheft „Schneller Bauen“, 2021.

[5] KOLBECK, L, ABUALDENIEN, J., VILGERTSHOFER, S. BORRMANN, A.: Graph Rewriting Techniques in Engineering Design: A Literature Review. Horizons of the built environment, 2021. [In Preparation]

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