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Invited Paper

Optimizing Structure and Process Design through Multi-objective Bayesian Methods

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ABSTRACT

Optimizing structure or process is complicated due to the 'black-box problem' where the objective functions are not readily discernible. Such problems also showcase numerous properties that are mutually exclusive, precluding a single optimal design solution. To counter this, we propose a data-informed framework for optimizing structural design and processing. We demonstrate this through two examples: a nacre-inspired composite and the injection molding process. For the composite, we used Gaussian process regression to model intricate relationships using data derived from the crack phase-field simulation. Subsequently, multi-objective Bayesian optimization was utilized to identify pareto-optimal composite designs with respect to toughness, strength, and lightness. To validate our approach, we fabricated a few pareto-optimal designs using a PolyJet 3D printer. Tensile tests confirmed these designs had been optimized for specific objectives. For the injection molding process, we introduce pareto-optimal parameters balancing cycle time and deformation, illustrating that larger products necessitate multiple packing stages.

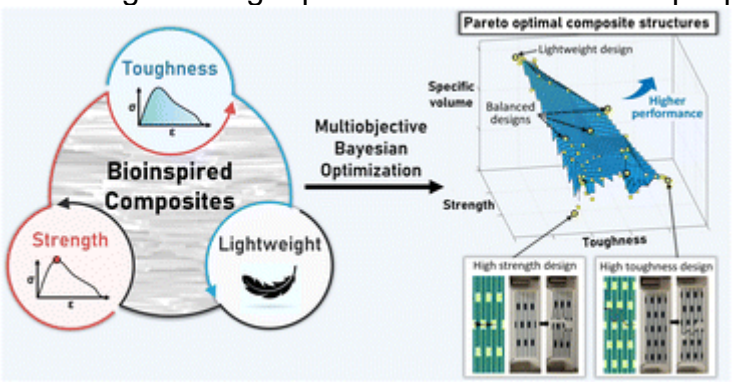

Fig. 1 Schematic of the Study

REFERENCES

Park, K., Song, C., Park, J., and Ryu, S. (2023), “Multi-objective Bayesian optimization for the designing of nacre-inspired composites: optimizing and understanding the biomimetics through AI”, *Materials Horizons, in print*.

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