

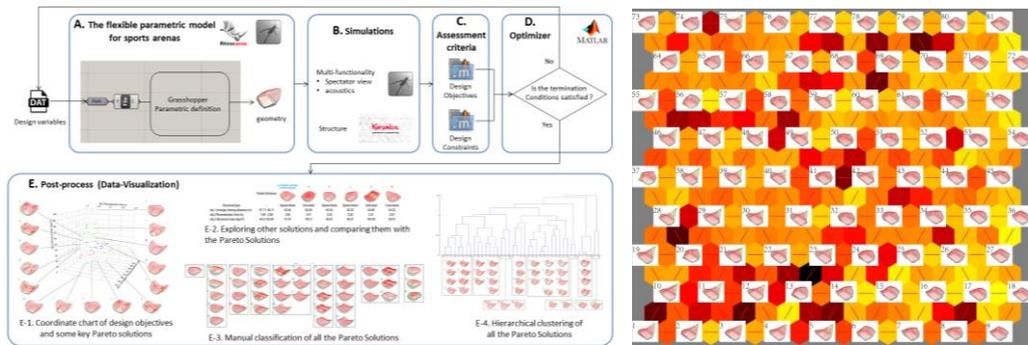
A Computation Strategy for the Conceptual Designs of Indoor Sports Arenas:

supporting the integration of the multi-functional space and long-span roof structure

Keywords: computational designs, indoor sports arena, multi-functional space, long-span structure

AE+T / Design Informatics (TOI)

Area of Research: Computational designs



Research Summary:

Sports arenas are a kind of important public buildings, which have large impacts for the society for their massive volumes, iconic forms, the importance of the activities they cater to, and their full-life-circle impacts on the environment. Specifically, the multi-functional space and long-span roof structure of arenas are highly interrelated and mainly define the overall forms of the buildings. Hence, how to design a proper configuration based on the integration of these two aspects are crucial for arena designs as well as the society and the built environment.

With the rapid development of digital and information technologies, a framework named performative computational architecture is widely used in architectural design, which can define well-performing designs by using parametric design, building performance simulations, and multi-objective optimization. Additionally, machine learning is also widely used in engineering fields to perform data prediction, data analysis, and knowledge discovery, which can be potentially used for architectural design to fulfill design exploration based on both hard and soft requirements.

To support the integration of the multi-functional space and long-span structure for arenas and design exploration according to multiple criteria during the conceptual design, this project proposes a design strategy by improving, customizing and combining the performative computational architectural design and machine learning methods.

Research Methodology:

- Literature review: To review the general characteristics, requirements about function and performance, and basic spatial compositions of indoor arenas; To review the principals, applications, limitations of the related computational tools and technologies (parametric modeling, building performance simulations, interactive multi-objective optimization based on evolutionary algorithms, machine learning methods)
- Experiments: To abstract some real designs into hypothetical designs as branch-marks and use the branch-marks to validate each step in the developments of the components.
- Case studies: To apply the developed components and the whole strategy in real designs, to validate the efficacy.

Key Publications:

- Pan, W., Sun, Y., Turrin, M., Louter, C., Sariyildiz, S. (2018) "Integrating the Multi-Functional Space and Long-Span Structure for Sports Arena Design: A design exploration process based on design optimization and self-organizing map" in Mueller, C., Adriaenssens, S. (eds.), Proc. IASS Annual Symposium 2018: Creativity in Structural Design. MIT, Boston, US. No.381
- Pan, W., Sun, Y., Turrin, M., Paul, J. (2016) "A Parametric Modelling Process for the Integration of Architecture and Structure in Large Multi-functional Sports Hall Design: a Case Study" in Kawaguchi, K., Ohsaki, M., Takeuchi, T. (eds.), Proc. IASS Annual Symposium 2016: Spatial Structures in the 21st Century. University of Tokyo, Tokyo, JP. No.1446



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Main Question:

How to integrate the multi-functional space and long-span roof structure of indoor sports arenas and how to support design exploration for conceptual designs based on computational designs?

Deliverables:

A versatile parametric model of indoor arenas;
A framework of multi-criteria assessment for indoor arenas;
Computational design process for the integration of the multi-functional space and long-span roof structure of indoor sports arenas.

Link(s)

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