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RELATED TOPICS ON SHAPE OPTIMIZATION FOR RIVER IMPROVEMENT

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ABSTRACT

To control flow conditions during floods, our research focuses on a rectifying structure designed to achieve "pseudo-laminar flow." Optimizing the shape and spatial arrangement of these structures requires the development of sophisticated topology and shape optimization methods based on the unsteady Navier-Stokes equations, ensuring precise simulations that can be rigorously compared with experimental data. This mini-symposium introduces a robust design framework by formulating a topology optimization problem that simultaneously optimizes the geometry and placement of these rectifying structures. By leveraging the essential spatiotemporal structure of high Reynolds number turbulent flow fields—on the order of 10^3—we offer a new approach to designing more reliable river infrastructure. Furthermore, our methodology aims to minimize the sensitivity of hydraulic performance to varying flood scales, ensuring that optimized geometries remain effective under diverse environmental conditions. By bridging the gap between theoretical fluid mechanics and practical hydraulic engineering, this work provides a sophisticated toolkit for the next generation of resilient, nature-compatible flood management systems.

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