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Section Fluid Sciences and Technology

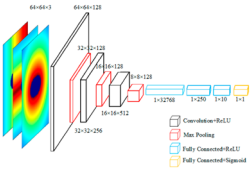
Featured Papers

DOI:10.3390/app12063147

Fully Convolutional Neural Network Prediction Method for Aerostatic Performance of Bluff Bodies Based on Consistent Shape Description

Authors: Ke Li, Hai Li, Shaopeng Li and Zengshun Chen

Abstract: The shape of a bluff body section is of high importance to its aerostatic performance. Obtaining the aerostatic performance of a specific shape based on wind tunnel tests and CFD simulations takes a lot of time, which affects evaluation efficiency. This paper proposes a novel fully convolutional neural network model that enables rapid prediction from shape to aerostatic performance. Its main innovations are: (1) The proposal of a new shape description method in which the shape is described by the combination of the wall distance field and the space coordinate field, which can efficiently express the influencing factors of the shape on the aerostatic performance. (2) A step-by-step strategy in which the pressure field is used as the model output and then the calculation of the aerostatic coefficient is proposed. Compared with the simple direct prediction of the aerostatic coefficient, the logical connection between input and output can be enhanced and the prediction accuracy can be improved. It is found that the model proposed in this paper has good prediction accuracy, and its average relative error is 9.42% compared with the CFD calculation results. Compared with the direct use of the shape as the model input, the accuracy is improved by 13.25%; compared with the direct use of the drag coefficient as the model output, the accuracy is improved by 10%. Compared with traditional CFD calculations and wind tunnel experiments, this method can be used as a fast auxiliary screening method for the optimization of the aerodynamic shapes of bluff body sections.

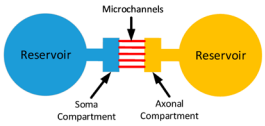


DOI:10.3390/app12073534

A Review on Microfluidic Platforms Applied to Nerve Regeneration

Authors: Chuankai Dai, Xiaoming Liu, Rongyu Tang, Jiping He and Tatsuo Arai

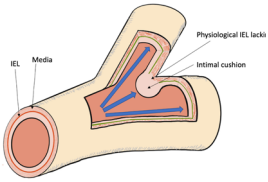
Abstract: In recent decades, microfluidics have significantly advanced nerve regeneration research. Microfluidic devices can provide an accurate simulation of in vivo microenvironment for different research purposes such as analyzing myelin growth inhibitory factors, screening drugs, assessing nerve growth factors, and exploring mechanisms of neural injury and regeneration. The microfluidic platform offers technical supports for nerve regeneration that enable precise spatio-temporal control of cells, such as neuron isolation, single-cell manipulation, neural patterning, and axon guidance. In this paper, we review the development and recent advances of microfluidic platforms for nerve regeneration research.



DOI:10.3390/app12125964

The Cerebral Arterial Wall in the Development and Growth of Intracranial Aneurysms

Authors: Pasquale Marco Abbate, A. T. M. Hasibul Hasan, Alice Venier, Vincent Vauclin, Silvia Pizzuto, Alessandro Sgreccia, Federico Di Maria, Oguzhan Coskun, Katsuhiro Mizutani, Georges Rodesch and Arturo Consoli

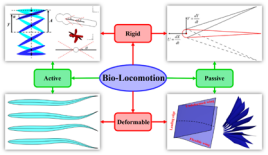


Abstract: A considerable number of people harbor intracranial aneurysms (IA), which is a focal or segmental disease of the arterial wall. The pathophysiologic mechanisms of IAs formation, growth, and rupture are complex. The mechanism also differs with respect to the type of aneurysm. In broad aspects, aneurysms may be considered a disease of the vessel wall. In addition to the classic risk factors and the genetic/environmental conditions, altered structural and pathologic events along with the interaction of the surrounding environment and luminal flow dynamics contribute to the aneurysm's development and growth. In this review, we have tried to simplify the complex interaction of a multitude of events in relation to vessel wall in the formation and growth of IAs.

DOI:10.3390/app13074208

Immersed Boundary Methods for Simulations of Biological Flows in Swimming and Flying Bio-Locomotion: A Review

Authors: Yuhang Zeng, Yan Wang, Dangguo Yang and Qing Chen



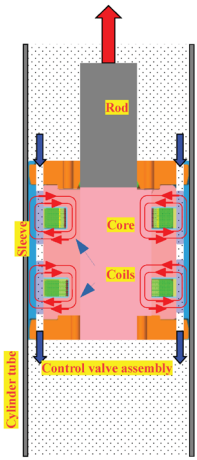
Abstract: Biological flows in swimming and flying bio-locomotion usually involve intricate flexible or rigid structures that undergo large deformations and displacements, as well as rich mechanisms of bio-fluid interactions. Immersed boundary methods (IBMs) have gained increasing prevalence in numerical investigations of such biological flow problems due to their simplicity and capability for simulating these problems on a Cartesian mesh, which does not require tedious grid-regeneration or mesh deformation processes. In recent years, the vigorous development of IBM variants has enriched numerical techniques for bionic simulations. This review focuses on the development of the IBM and its applications in the field of biological aerodynamics and hydrodynamics, including both diffuse and sharp interface IBMs. The fundamentals of the former are introduced in detail, and the hybrid Cartesian-IBM is briefly presented as one representative method of the latter. In particular, the velocity correction IBM is highlighted in the diffuse interface IBM due to its superiority in accurately satisfying no-slip boundary conditions. To shed light on the dynamic characteristics of flying and swimming behaviors with predefined or passive motion and deformation, some recent results from IBM applications are also presented. Finally, this review discusses some challenges and promising techniques in the research of bio-inspired motions based on the IBM.

Featured Papers

DOI:10.3390/app12126260

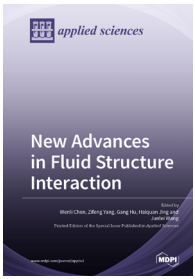
Review: A Survey on Configurations and Performance of Flow-Mode MR Valves

Authors: Janusz Gołdasz, Bogdan Sapiński, Michal Kubík, Ondřej Macháček, Wojciech Bańkosz, Thomas Sattel and Aditya Suryadi Tan



Abstract: Magnetorheological (MR) actuators are semi-active devices controlled by magnetic stimuli. The technology has been commercialized in the automotive industry or high-quality optical finishing applications. It harnesses the rheology of smart fluids to result in the unique application of the material. By a wide margin, the most common example of an MR actuator is a flow-mode single-tube housing with a control valve (electromagnet with a fixed-size air gap filled with the MR fluid) operating in a semi-active vibration control environment. The analysis of the prior art shows that the developed configurations of MR valves vary in size, complexity, the ability to generate adequate levels of pressure, and the interactions with the MR fluid's rheology resulting in various performance envelopes. Moreover, miscellaneous testing procedures make a direct valve-to-valve comparison difficult. Therefore, in this paper we present a detailed and systematic review of MR control valves, provide classification criteria, highlight the operating principle, and then attempt to categorize the valves into groups sharing similarities in the design and performance envelope(s). Moreover, a simple performance metric based on the shear stress calculation is proposed, too, for evaluating the performance of particular valving prototypes. In the review, we discuss the key configurations, highlight their strengths and weaknesses and explore various opportunities for tuning their performance range. The review provides complementary information for the engineers and researchers with a keen interest in MR applications, in general. It is an organized and and critical study targeted at improvements in the categorization and description of MR devices.

Books



New Advances in Fluid Structure Interaction

Multiphase Flows in Microfluidics: Fundamentals and Applications

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