

21 世紀 C O E 「流動ダイナミクス研究教育拠点」  
分野横断特別セミナー

日 時： 1 月 21 日(月) 15 : 30

場 所： 流体科学研究所 COE 棟 3 F セミナー室

講演者： Dr. Adrian Bejan

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題 目： Natural and Designed Vascular and Multi-Scale Flow Architectures

要 旨 / Abstract :

In this lecture I review several recent developments to illustrate our progress on “design with constructal theory”. Constructal theory is the view that the generation of “designedness” in nature is a phenomenon of all physics (geo, bio, socio), which is covered by a deterministic principle (the constructal law): “for a finite-size flow system to persist in time (to live) it must evolve such that it provides easier and easier access to the currents that flow through it”.

First is the development of smart materials with embedded vasculatures that provide multiple volumetric functionality: heat and mass exchange, self-cooling, self-healing, enhanced apparent thermal conductivity, etc. Vascularization is achieved by using tree-shaped flow architectures. As the smallest length scale becomes smaller, tree designs provide dramatically superior volumetric bathing than the use of parallel channels. The second development is the discovery of flow structures (parallel plates, bundles of cylinders in cross flow) with multiple scales, which offer greater volumetric heat transfer densities than assemblies having a single length scale (plate length, cylinder diameter, spacing between adjacent plates, etc.).

In sum, novel flow architectures are derived from principle, in accordance with the constructal law, not by mimicking nature. Additional examples show how constructal designs provide (1) strategy for engineering and (2) predictive power for explaining the occurrence of design in nature, throughout the animate and inanimate realms (e.g., turbulence, river basins, lungs, snowflakes, animal locomotion, Egyptian pyramids, and social dynamics).

Brief constructal bibliography:

[www.constructal.org](http://www.constructal.org)

- A. Bejan, *Advanced Engineering Thermodynamics*, 2<sup>nd</sup> ed., Wiley, New York, 1997.
- A. Bejan and S. Lorente, *Constructal theory of generation of configuration in nature and engineering*, *Journal of Applied Physics*, Vol. 100, 2006, 041301.
- A. Bejan and S. Lorente, *Design with Constructal Theory*, Wiley, Hoboken, 2008, in press.