Edited by:
DSL CONFERENCE

Conference Book

DSL2015 - Munich-Germany

22-26 JUNE, 2015

www.dsl-conference.com

Conference Venue:
NH München Messe
Eggenfeldener Str. 100.
D-81929 Munich (Germany)

MANAGEMENT:
ICC- International Conferences and Courses Limited / www.icc-conferences.com

PREFACE

It is our great pleasure to welcome you to the **11th INTERNATIONAL CONFERENCE ON DIFFUSION IN SOLIDS AND LIQUIDS: DSL2015** (Munich, Germany, from 22-26 June, 2015).

DSL-2015 aims at attracting a balanced portion of delegates from academia, industry and research institutions and laboratories involved with research and development work. In doing so, the conference provides a binding platform for academics and industrialists to network together, exchange ideas, provide new information and give new insights into overcoming the current challenges facing the academics and the industrialists relating to mass transfer, heat transfer, microstructure and properties, nanodiffusion and nanostructured materials.

I would like to thank the Organising Committee members and members of the Local Committee for their help in contributing to the successful organisation of this meeting and especially give thanks to Professor Stan Veprek for his support to help participants to get VISA's from the German Embassies.

I would also like to sincerely thank the organisers of the SPECIAL SESSIONS for their great work!

A special "thank you" as well to Professor Graeme Murch, Professor Ali Shokuhfar and Professor João Delgado, co-chairs of DSL-2015, for the excellent work, significant inputs and support to this conference.

You all made the way to Munich and I would like to personally thank you and all delegates for the decision to attend DSL 2015. I hope that you will find the meeting very useful for your work and business, as well as a useful forum for obtaining new knowledge.

Have fun learning and meeting new people!

See you again in 2016!

12TH YEAR OF DSL!

Professor Andreas Öchsner
DSL CONFERENCES – Chairman

TABLE OF CONTENTS:

VIP024
Prof. Antonio F. Miguel
University of Evora
Evora - Portugal

Why does some biological networks deviate from Hess-Murray law and why is this question of importance?

Antonio F. Miguel

Department of Physics, University of Evora & Institute of Earth Sciences, Portugal

Complex flow systems such as the vascular and respiratory trees are made of large and small vessels in series. This compromise between large and small vessels is due to the fact that systems involve both translational and transmural flows. The optimal arrangement of vessels in these tree-networks seems to obey to Hess-Murray law, which pointed out a relationship that links the radius of a parent vessel (immediately upstream from a vessel bifurcation) to the radii of the daughter (immediately downstream after a vessel bifurcation): the reduction of vessel size by a constant factor ($2^{-1/3}$). However, there are some experimental evidences that there are tree-networks that present larger sizes than predicted by the Hess-Murray law (e.g. the acinar airways of the respiratory tree). How and why is this possible? Is the maximum physical efficiency, in some cases, not a sufficient criterion for the physiological design?

In this study we describe the fluid flow through several tree-networks arrangement based on constructal law. We show that the physical optimization (maximal flow access) in the tree-network design is not always given by a reduction of vessel size by a constant factor of $2^{-1/3}$.

References

C.D. Murray (1926) The physiological principle of minimum work. I. The vascular system and the cost of blood volume, Proc. Natl. Acad. Sci. USA 12, 207–214.

G. B. West, J. H. Brown, B.J. Enquist (1997) A general model for the origin of allometric scaling laws in biology, Science 276, 122–126

A. Bejan, S. Lorente (2008) Design with Constructal Theory, Wiley, New Jersey

A. F. Miguel (2014) Dendritic design as an archetype for growth patterns in nature: fractal and constructal views. Frontiers in Physics 2:9, 1-7

A. F. Miguel (2015) Fluid flow in a porous tree-shaped network: Optimal design and extension of Hess–Murray's law, Physica A 423, 61–71