Vascular Adaption Dynamics – An old idea probed with modern techniques

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The complex relationship between vascular network morphologies, their role in nutrient or drug transport and the influence of solid tumors is focused by our research.
Traditionally the radii of a hierarchical transport networks such as the vasculature are observed to follow the formula of Murray which can be derived from basic physical principles. Despite of giving a good estimate on what to expect, the formula provides no further biological insides.
In the past, Secomb et. al. [1] proposed a biologically motivated scheme to dynamically regulate blood vessel radii where the topology as well as the metabolic demand of surrounding healthy tissue is taken into account. So far this approach was used to describe observed data from rat mesentry networks. High Performance Computing together with modern evolutionary optimization algorithms [2] enables us to apply the proposed adaptation scheme to artificial vasculatures created by our in house software package called "tumorcode".
Preliminary results show that Murrays law is not strictly fulfilled in the scope of that model. We present corresponding hydrodynamic distributions and study the influence on the oxygen distribution. The long term goal would be to understand the hierarchical signalling process and its malfunction caused by tumors.

[1] Pries, A. R., Reglin, B. & Secomb, T. W. Structural adaptation of microvascular networks: functional roles of adaptive responses. *American Journal of Physiology - Heart and Circulatory Physiology* **281,** H1015–H1025 (2001).

[2] Fortin, F.-A., Rainville, F.-M. D., Gardner, M.-A., Parizeau, M. & Gagné, C. DEAP: Evolutionary Algorithms Made Easy. *Journal of Machine Learning Research* **13,** 2171–2175 (2012).