A new model for the emergence of vascular networks

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Résumé

The generation of vascular networks is a long standing problem which has been the subject of intense research in the past decades, because of its wide range of applications (tissue regeneration, wound healing, cancer treatments etc). The mechanisms involved in the formations of vascular networks are complex and despite the vast amount of research devoted to it there are still many mechanisms involved which are poorly understood. Our aim is to bring insight into the study of vascular networks by defining heuristic rules, as simple as possible, and to simulate them numerically to test their relevance in the vascularization process. We introduce a hybrid agent-based/continuum model coupling blood flow, oxygen flow, capillary network dynamics and tissues dynamics. We provide two different, biologically relevant geometrical settings and numerically analyze the influence of each of the capillary creation mechanism in detail. All mechanisms seem to concur towards a harmonious network but the most important ones are those involving oxygen gradient and sheer stress.

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