Vascular Network Optimization Using Genetic Algorithm: A Computational Study

Sima Mehri, Curtis Larsen, Nicholas S. Flann

***Abstract*—Put our abstract here.**

***Key Words*—Systems Biology, Agent-Based Model, Parameter Estimation, Optimization, Micropatterning, Vascular endothelial growth factor (VEGF).**

I. INTRODUCTION

Introduce the science and the relevancy of the work here.

II. MULTICELLULAR EXPERIMENT AND MODEL

Describe the study here.

III. METHOD

Explain the research method here. How did we study the problem?

IV. RESULTS

Building upon Davis et al, a two dimensional factory was used in this work. The height of the factory was set to 0.768 mm while the width was fixed at 1.536 mm. The total number of producer and vascular cells were 4200 and 1800, respectively where vascular cells contributed to 30 per cent of total number of cells. A total of 384 circulatory cells simulating the external delivery and product extraction system existed as two identical columns on two sides of the factory. The number of all mentioned cells were kept constant through the experiment. The simulations started with a random distribution of producer and vascular cells inside the factory. After 16 simulation hours, the factory started the production phase provided the existence of a network of vascular cells. The aggregate product amount collected by the vascular network and circulatory columns was output after 2 simulated hours as the final throughput of the system.

A genetic algorithm with a population of 3 chromosomes over an evolution of 500 steps was used for obtaining the optimal values for the seven mentioned parameters.

Figure 1 shows the throughput of our cell factory during the evolution of this genetic algorithm. After 500 sweep iterations, the highest total product of the factory reached 616.65788 ug. The parameter values contributing to the best case are shown in Table 1. The factory related to these parameters is depicted in figure 2.

V. CONCLUSION

Wrap up the conclusions here.

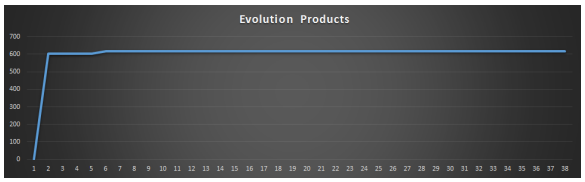

Fig. 1: The amount of product values $Product$ with evolution number It

TABLE I: The best parameter values the genetic algorithm has identified

Parameter	Value
Chemotactic Strength With Gradient	2.34110242590437
Vascular Cells' Production Rate	6.1583863371631
Circulatory Cells' Production Rate	4.26190176330675
Vascular Cells' Chemo-attractant Decay Rate	0.00839922309567474
Circulatory Cells' Chemo-attractant Decay Rate	0.0000282503099488372
Vascular Cells' Half-saturation Rate	0.0092723921166939

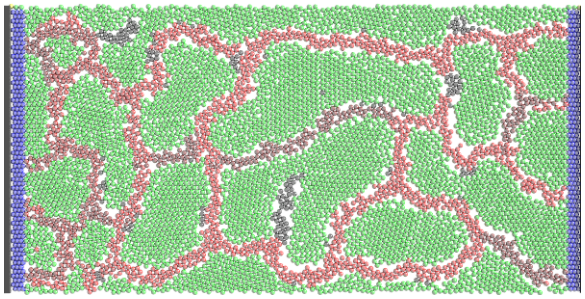

Fig. 2: The factory with the highest throughput which was found by the GA

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