12-9-2021

A Computational Model of Angiogenesis in Wet Age-Related Macular Degeneration

Brandon Pace
Utah State University, a01818577@usu.edu

A computational model of angiogenesis in wet age-related macular degeneration

Brandon Pace
Utah State University
Kelsey Bradshaw
Utah State University
Dr. Zhen Zhang
Utah State University
Dr. Elizabeth Vargis
Utah State University

Introduction

By age 80, 1 in every 4 Americans will suffer partial blindness because of age-related macular degeneration (AMD). There is no cure, and treatments to halt the progression consist of biweekly eye injections.

Little is known about AMD due to limitations in lab models on long-term diseases. Simulating proteins and progression with computers can help us learn and test ideas effectively.

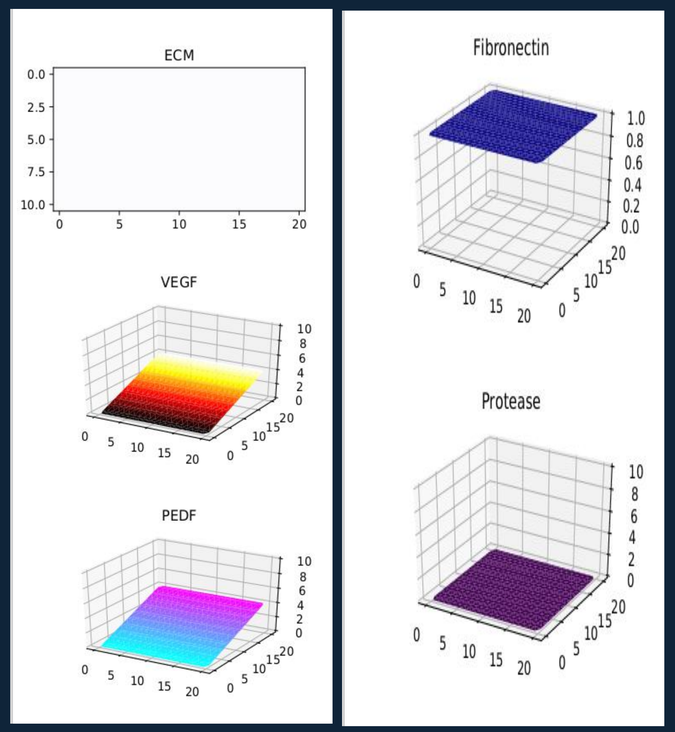
Methods

Wet AMD is enhanced by capillary growth in the back of the eye.

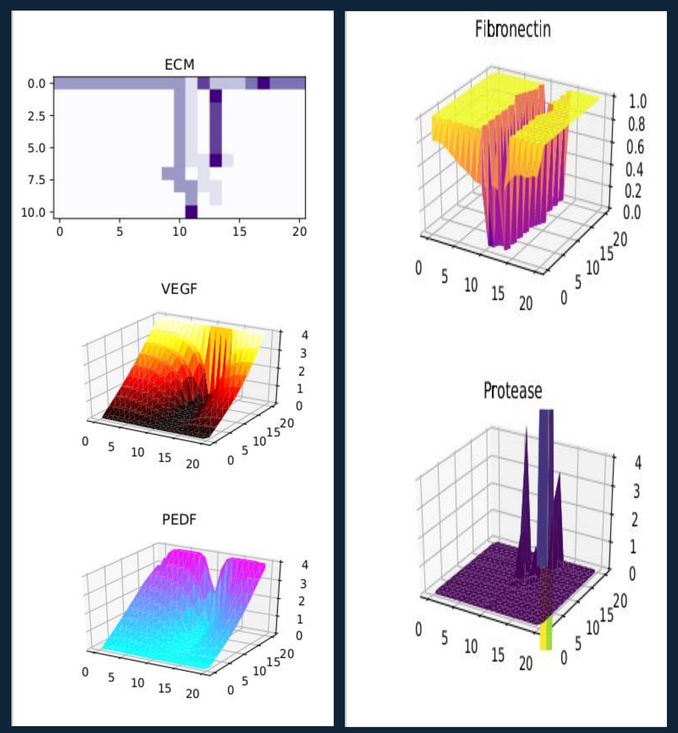
This computer model tests various protein expressions which can be from healthy or diseased cells.

Observing the blood vessel growth that occurs over time can give us insight into how differences in protein expression affects AMD.

Learn more here!



This model compares a healthy simulation, where PEDF and VEGF are expressed in equal amounts, to a diseased simulation, when PEDF decays over the course of 48 hours.



ECM: Extracellular matrix, your eye
VEGF: A protein that causes capillary growth
PEDF: A protein that is believed to inhibit capillary growth
Fibronectin: The main protein in the ECM
Protease: An enzyme that destroys fibronectin

UtahStateUniversity

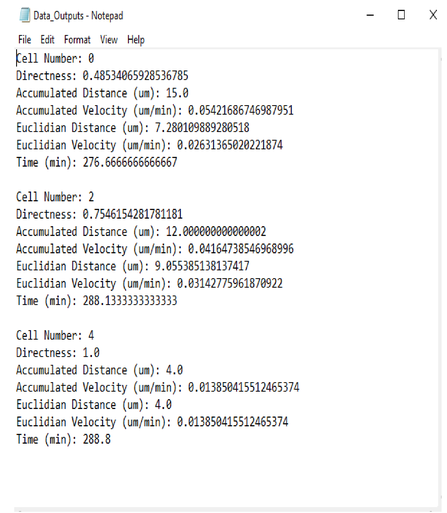
NIH

Results

Simulations show that when PEDF and VEGF expression remain equal, no capillary growth is present.

As PEDF expression decays over time, capillaries grow from the parent vessel towards the source.

Important outputs such as velocities, direction, and time can be examined to greater understand disease progression over time



The above image shows important outputs, such as velocities, for blood vessel growth

Stochastic Simulation

An important part of this simulation is that it is a probabilistic model. Equations are used to generate probabilities in movement to help represent the randomness found in biology

Extra results

Advancements in this model will include treatments to test effectiveness in preventing AMD