AGGREGATION OF MICROGLIA IN 2D WITH STRING GRADIENT WEIGHTED MOVING FINITE ELEMENTS

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Abstract. Alzheimer's Disease (AD) is a severe neurodegenerative disorder characterized by cognitive impairment and dementia. In the AD-affected brain, microglia cells are up-regulated and accumulate at senile plaques, the most prominent pathological feature of AD. In order to further study and predict the movement of activated microglia, we utilized their chemotactic properties. Specifically, we formulated the string gradient weighted moving finite element method (SGWMFE) for a system of partial differential equations in two dimensions which includes non-linear diffusion of a different variable found in chemotaxis models. The method was applied successfully to solve highly non-linear chemorepulsion-chemorepellent models in two-dimensions and the results were compared to one dimensional results found previously in the literature. We conclude that SGWMFE is easily applied to chemotaxis models, in particular movement and aggregation of microglia, resulting in the ability to study the models extended in two dimensions efficiently. Our study highlights the feasibility and power of mathematical modeling to advance our understanding of pathophysiological processes in neurodegenerative diseases, including AD.

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