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Edited by:

Mihailo Lazarević
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The dependence of the cluster properties on the time lag, noise intensity, and the synaptic strength is investigated. We have studied the dynamics of a collection of stochastically perturbed Fitzhugh-Nagumo excitable units with time-delayed diffusive couplings. Also, in part, the strategy to analyze global dynamics rests on deriving the mean-field (MF) approximation for the exact system.

M3b: Miloš Kojić, Miljan Milosević, Vladimir Simić
CONVECTION–DIFFUSION TRANSPORT MODEL USING COMPOSITE SMEARED FINITE ELEMENT

The mass exchange from blood vessels to tissue and vice versa occurs through blood vessel walls. Due to geometrical complexity and heterogeneity of capillary systems, it is not feasible to model *in silico* individual capillaries for the entire organ domains. Hence, there is a need for simplified and robust computational models that address mass transport in capillary-tissue systems. We introduced a smeared modeling concept for gradient-driven mass transport and formulated a new composite smeared finite element (CSFE) [1]. The introduced CSFE is composed of two volumetric parts - capillary and tissue domains, and has four nodal degrees of freedom (DOF): pressure and concentration for each of the two domains. The domains are coupled by connectivity elements at each node. The smeared concept is implemented into our implicit-iterative FE scheme and into FE package PAK. Examples tested for the purpose of this study illustrate accuracy of the CSFE element, robustness of the introduced methodology and its applicability in real physiological conditions.

M3c: Andjelka N. Hedrih, Katica (Stevanović) Hedrih
RESONANCE AS POTENTIAL MECHANISM FOR HOMOLOG CHROMOSOMES SEPARATION TROUGH BIOMECHANICAL OSCILLATORY MODEL OF MITOTIC SPINDLE

During uniform distribution of chromosomes throughout cell division process an important role plays complex machinery called mitotic spindle. Biomechanics of mitotic spindle is very complex involving specific forces generated in the- and outside the spindle. Elongation speed of mitotic spindle, as well as elongation length of mitotic spindle during anaphase B mainly depends on cell type and conditions in which cell division take place. There are several theoretical models of anaphase B: slide and flux or elongate model, slide and cluster model, and cell size dependent spindle elongation model. The aim of this work was to consider a mitotic spindle as a system of coupled oscillators and to analyze the conditions for sister chromatid separation in anaphase trough the biomechanical oscillatory model of mitotic spindle. The basic concept of biomechanical model of mitotic spindle is given: centrosomes are presented as mass particles that represent two rheonomic centers of oscillations. Microtubules are presented with standard light visco-elastic element. Sister chromatids are represented as mass particles that are interconnected with standard light massless elastic spring. Homologue chromosomes have equal masses and different chromosomes have different masses. In the case of excitation of reonomic centers of oscillations each with a single frequency, two differential equations of motion for each pair of homologue chromosomes are given. An expression for total mechanical energy of oscillating pair of homologues chromosomes is also given. We assume that resonance could

be a condition for disconnection of homologue chromosomes that is desirable event in anaphase, but also resonance could also be the condition (form the mechanical point of view) for disconnection between kinetochore and microtubule which, when occurs, leads to aneuploida-non equal distribution of genetic material between cells. Conditions for resonance occurrence are analyzed.

M3d: Miljan Milosević, Milos Kojić, Vladimir Simić
FIELD OF CORRECTION FACTORS FOR SMEARED FINITE ELEMENT

Motivation for this paper came from the need for simplified and robust computational models that address mass transport in capillary-tissue systems. Recently introduced composite smeared finite element (CSFE) provides a new methodology of modeling complex diffusion transport in capillary and tissue domain [1]. The fictitious connectivity elements take into account the surface area of capillary walls which belong to each node, as well as the wall material properties (permeability and partitioning). The transport from capillary system is first smeared to continuous mass sources within tissue, under the assumption of uniform concentration within capillaries. Here, the fundamental relation between capillary surface area and volumetric fraction is derived as the basis for modeling transport through capillary walls. Despite all these assumptions and theoretical considerations, there are still differences in overall mass transport when comparing a detailed 3D model and a smeared model. We investigated different parameters of the smeared model such as: ratio of thickness / diameter of capillary wall, ratio of diffusion coefficient in capillary wall / surrounding tissue, and volume fraction of capillaries within tissue domain on accuracy of the smeared model. We explored field of correction factors which have to be added to the smeared model in order to have the same response as for the detailed 3D model. Examples with complex configurations of capillary networks showed applicability of correction factors, improved accuracy of smeared models, and encouraged the use of smeared model in real problems such as models of tumor or human organs.

M3e: Milica M. Nikolić,Nenad D. Filipović
APPLICATION OF DPD METHOD ON MODELLING SEMICIRCULAR CANALS

In this paper modeling of semicircular canals using Dissipative Particle Dynamics (DPD) is presented. The role of the Semi Circular Canals (SCC) is to secure balance, specifically rotational motion. Translational motion is regulated with utricle, which is placed in vestibule and presents a chamber in front of the semicircular canals. Each ear has three semicircular canals, containing certain amount of fluid. These canals are positioned in three orthogonal planes. During the rotational motion, fluid moves inside the canals, exposes pressure on the cupula – membrane inside the canal, which activates nerves and sends information about the change of the position to the brain. Three planes of the SCC provide information about rotation around each axis. Movement of the fluid inside the canal and deformation of the cupula were modelled with DPD method, which is the first time that this discrete method is used for modelling of SCC. Displacement of the cupula was analysed and compared to the existing data from literature, as well as force on the membrane. The obtained results are in good agreement with the existing data and DPD method can be used for modeling of SCC.

CERTIFICATE OF PARTICIPATION

This is to certify that

ANĐELKA HEDRIH

Participated in the

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