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# Biological cells adhesion mediated by receptors–ligands binding

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## ABSTRACT

Cell adhesion plays a vital role in many cell activities. The motivation to model cell adhesion is to study important biological processes, such as cell spreading, cell aggregation, tissue formation, and cell adhesion to biomaterials. This study provides important insight into cell adhesion, which can lead to improve regenerative medicine and tissue formation techniques. In this study, we focus on modeling the adhesion of biological cells mediated by receptors–ligands binding and the diffusivity of the receptor on the cell membrane surface. The ability of receptors to diffuse on the cell membrane surface yields a very unique and complicated adhesion mechanism, which is excusive to cell membrane. The biological cell is modeled as a fluid-like membrane with negligible bending stiffness enclosing a cytoplasm fluid. The mobility of the receptor on the cell membrane is modeled using the diffusion equation. The phospholipid bilayer, which is the main component in the cell membrane, shows fluid-like behavior associated with the molecules' diffusivity. The in-plane mechanical behavior of the cell membrane is assumed to depend only on the area change, which is motivated by the fluidity of the phospholipid bilayer. In addition, the presence of receptors influences the local mechanical properties of the cell membrane. The influence of the receptor density is accounted for by including stress-free area change, which depends on the receptor density. Based on the physical properties of the receptors and ligands we modeled the attraction between the receptors and ligands as a charged-nonpolar which is a noncovalent interaction. Such interaction is a short-range type, which decays fast with distance. Fick's law is used to model the receptor–receptor interactions. The resultant interaction force, which includes receptor–ligand and receptor–receptor interaction, is decomposed into tangential part, which governs the receptor diffusion, and normal part, which governs the cell deformation and adhesion. The formulation of the governing equations and numerical simulations will be presented.