ABSTRACT

Magnetic hyperthermia is a type of cancer treatment using a magnetic nanoparticle drug carrier to transform external electromagnetic energy into induction heating in the targeted tumor region. Passive molecular communication is used as a transport indicator from the injection point (the transmitter) to the targeted tumor region (the receiver). However, through this method, there is a possibility of deficient BER performances and damage to the healthy tissue region. Sufficient parameters and a biological coating layer such as G-protein are one of the solutions.

This thesis simulates passive molecular communication via diffusion with various parameter include the distance between the transmitter and the receiver, the diffusion coefficient, the number of emitting molecules, the threshold value, and type of modulation using MATLAB to calculate the number of receive molecules and BER performance to indicate the quality of the communication. After the reception process of the molecules in the targeted tumor, the simulation of magnetic hyperthermia with various parameters include the shape, size, coating material, and thickness of the nanoparticle using COMSOL to calculate the highest achievable temperature, distribution of bioheat, and the amount of damage area regarding the surrounding healthy tissue.

This thesis found that: (i) Sufficient parameters such as shorter distance between the transmitter and the receiver, more emitting molecules, optimum threshold, and higher diffusion coefficient value enhance the error performance, (ii) Binary Molecular Shift Keying (BMoSK) modulation produces better BER performances than Binary Concentration Shift Keying (BCSK) modulation, and (iii) The proposed G-protein coating for the magnetic nanoparticle that performs the same behavior as the polymer produces the highest achievable temperature, evenly distributed bioheat, and decreases the amount of damage on the healthy tissue region.

Keywords: Molecular Communication, Nanoparticles, Magnetic Hyperthermia