As the automotive industry has shifted its focus towards electric-powered vehicle development, the demand for effective Li-ion battery cells has surged. To reach optimal performance levels these modern batteries function at higher and narrower operating temperature ranges. These conditions present significant obstacles for design engineers; they must tackle greater safety risks, shorter battery lives, and hindered efficiencies amongst other power problems. Research has been undertaken to investigate how an effective cooling system can be utilized to prevent overheating and to ensure heat dissipation away from the battery cells. These cooling systems are part of what is known as a Battery Thermal Management System (BTMS).

A numerical model of the Li-ion batteries found in electric vehicles is developed and the effectiveness of different thermal management systems is assessed. MATLAB is used for simulating the heat flux into and out of a 2-dimensional battery cell. The code is marched through time. Different boundary conditions are set representative of varying thermal management systems including submersion of the cell in Phase-Change Material and using an internal cooling channel. The effect of cell thermal conductivity is evaluated; higher thermal conductivity can be achieved through the addition of graphene nanoparticles to the cell.

The numerical model developed in this project was validated against experimental data from open literature and was found to be accurate in predicting maximum temperature to within 96%. Results agree with the experiment and show high peak temperatures in excess of the recommended range under some conditions. The model was adapted to simulate the effect that BTM systems would have on the thermal patterns found in the cell. Results show that by adopting a combination of these systems, the maximum temperature can drop by over 40%. An optimal solution is presented which is efficient and practical in meeting the cooling demands and is an amalgamation of two BTMS systems.