Optimization of Control Algorithm in Mild Hybrid Vehicles to Improve Fuel Economy

Overview
Using a crank integrated starter generator mild hybrid electric vehicle model from Autonomie; the team was tasked to redesign the vehicle propulsion control algorithm to establish new targets, analyze data sets and trends, and ultimately redesign the algorithm to improve fuel economy.

Objectives
Our objective was to redesign the control algorithm to establish new targets, analyze data sets and trends, and ultimately improve fuel economy in the mild hybrid model using Autonomie. Our deliverable was to outline procedures to increase vehicle fuel economy while minimizing the impact to the performance and drivability of the Hyundai mild hybrid cycles: Highway, City, and US06.

Approach
- Researched all relevant information regarding current testing methods of the EPA
- Worked with Hyundai to develop what customer needs, mainly fuel economy, to focus on
- Performed patent and new technology research on Mild Hybrid Electric Vehicles
- Worked extensively with Hyundai to understand
  - The current control algorithm in place
  - Exactly how Mild Hybrid Vehicles operate and if there are any existing issues to focus on
- Held weekly conference calls to compare each team’s findings and ideas from the week
- Performed transient modeling simulations through Autonomie and Simulink StateFlow
  - Results were exported to excel where they were then analyzed for trends
  - Simulation Results would then influence our future iterations of testing
- Developed Deceleration Fuel Cut Off (DFCO) algorithm to further aid in increasing fuel efficiency

Outcomes
- Fuel efficiency increase of 0.467% during US06 (City) cycle
- Fuel efficiency increase of 0.036% during HWFET (Highway) cycle
- Fuel efficiency increase of 0.235% during US06 (Sport) cycle
- Provided Hyundai with entirety of research done to influence our changes in the algorithm

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Original Efficiency (MPG)</th>
<th>Optimized Efficiency (MPG)</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTP</td>
<td>37.0880</td>
<td>37.2618</td>
<td>% 0.469</td>
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<tr>
<td>HWFET</td>
<td>45.7532</td>
<td>45.7698</td>
<td>% 0.036</td>
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<tr>
<td>US06</td>
<td>28.8833</td>
<td>28.9511</td>
<td>% 0.235</td>
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