

**GM Mentors:**

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**1.5L Turbo SGE Stochastic Pre-Ignition Project**

Downsized boosted SIDI engines are capable of reducing light duty vehicle fuel consumption, and are likely a key element for 2025 CAFE fuel economy compliance. Combustion occurs under high pressures within these engines, leading to the more frequent onset of limit phenomena such as stochastic pre-ignition (SPI) at low speeds and high loads. Leading studies suggest that the SPI phenomena is initiated through localized hot spot ignition, for example hot spots associated with elevated component temperatures, deposit flakes or spurious oil droplets. The process is thought to occur stochastically and the resulting end-gas auto-ignition phenomena consumes most to all of the fuel air mixture, producing excessive peak cylinder pressures and pressure rise rates, which can quickly lead to catastrophic engine failure. As a result of the SPI limit phenomena, the full fuel economy potential of downsized boosted SIDI engines cannot be recognized.

Students who join this project team will develop a pressure model of the pressures seen by the piston during an SPI event. Then correlate the results to the current known failure mode of the piston, while providing feedback to the GM engine community at large.

**Student Team Objectives**

- A. Literature survey to establish an understanding of SPI phenomenology, parameter dependencies, testing and analysis methods.
- B. Devise an experimental design to establish the pressures seen by the piston during an SPI event and determine the location of the point that the SPI event initiated.
- C. Use combustion analysis tools to support testing and analytical efforts.
- D. Develop model of the pressure gradient in the combustion chamber during an SPI event.
- E. Compare the current known failure mode of the piston during an SPI event with the FEA load case developed by GM and the pressure gradient model developed by the team.
- F. Provide feedback to the engine community at GM.

**Desired Student Skillsets**

Modeling, Design, Simulation & Testing: Mechanical Engineering, ISD-Auto, ISD-Mfg (3-4)

Data Analysis & predictive analytics: SI or STATS (1-2)

**Additional skills desired:**

- A. MATLAB
- B. Thermodynamic modeling experience (GT-Power)
- C. Heat release/combustion analysis software experience

**Legal**

Participation on this project team is open to all students regardless of citizenship status\*

\*Note: only US citizens will be considered for a summer internship.

Students will sign a GM Non-Disclosure and IP Agreement