Project title: Differential equation solver using a spectral method in an Intel FPGA

Brief Description of Design Project Goals:

Overview:
A differential equation is a function that involves derivatives which has applications in heat conduction, plasma, fluid dynamics, and quantum mechanics. Despite their wide range of application, only the simplest form can be solved explicitly and a numerical method should be applied to find the approximate solution in a computer.

Many different methods such as the finite difference method and spectral method were developed to numerically solve the differential equation. The pseudo-spectral method is one of them that uses FFT and inverse FFT to solve the diffusion equation and the Vlasov equation. SonicMEMS lab is developing a spectral method on a Stratix 10 FPGA to improve the speed and accuracy of solving these equations.

Specific MEng Contribution:
- Design a program that uses 1D FFT and 2D FFT on Matlab and on Python
- Write a program on Matlab that can solve the differential equation using the pseudo-spectral method with the FFT
- Design and test Verilog IP Cores using an Intel FPGA
- Implement a FFT program with the IP Cores to solve the differential equations

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Number of MEng Students Needed: 1-2

Required Skills:
- Basic skills in programming Verilog
- Skills to implement simple numerical analysis with Python, and Matlab
- Understanding of differential equation, numerical analysis, and fast Fourier transform(FFT)
- Signal processing

Estimated Project Time Frame:
2018-19 Academic Year, Two (2) Semesters