

Background:

Hypothesis: The current optimal control tools can benefit from distributed computing, however, this is not a capability of current optimal control tools. By developing an optimal control tool that takes advantage of distributed computing the NLP solver will be able to operate much faster than current tools. This will help enable online optimal control in addition to making the use of optimal control increasingly available for different audiences.

Improved optimal control tools will allow greater increases to be made with renewable energy. Can improve optimal control tools by creating an NLP solver that can take advantage of parallel processing.

Work Plan: I will begin my work by first gaining increased capability with current NLP solvers. I will then begin writing my own NLP solver. Once the solver has been written I will work on making it capable of taking advantage of parallel processing. The final step will be to optimize the code for speed as much as possible such that it will be the optimal control solver of choice.

Intellectual Merit:

Distributed computing will allow large decreases in time to compute. Will allow potential for onboard optimal control. Will allow for solving of bigger problems. Current NLP solvers not designed to take advantage of parallel processes

Broader Impact: The optimal control tools developed will enable new systems to be subject to optimal control that would otherwise have been untractable. This optimal control tool will bring a direct impact towards the energy sustainability of the nation. In order to move towards complete energy self sufficiency there will be many products and procedures that will need to be done in an optimal manner, otherwise they will not have the economic viability to be a long term solution. An example of a place optimal control can be used in renewable energy is the case of wind turbines that are essentially placed in blimps so that their vertical location can be adjusted to meet the highest wind speeds. Optimal control can be used in this location in order to balance moving the turbine to produce maximum electricity while expending as little energy as possible in the adjustments.

Another place that will benefit from optimal control tools utilizing distributed computing is space systems. On space systems the processors have to be radiation shielded for protection but as a result they can not be run very fast due to risk of overheating. This means in order to increase processing speed additional processors are needed to be used. This means that an optimal control tool that is to be used on

Increased ability to solve optimal control problems. Fits nicely with naturally distributed problems (ex. electric grid, air traffic control, etc.). Space processors have to be slow so that they do not overheat inside their radiation shields and so optimal control will be feasible onboard if multiple processors are able to be used.