BrightSpot Automation LLC Solar Panel Inspection Software Project

o **Company background**: BrightSpot Automation sells systems worldwide to image defects in photovoltaic (PV) solar cells and solar panels. Imaging technologies include electroluminescence, photoluminescence, and UV fluorescence. BrightSpot customers are found throughout the PV value chain including R&D labs, product development groups, cell and panel production groups, quality control groups, testing labs, equipment suppliers, materials suppliers, certification testing labs, distributors, and field testing groups. BrightSpot's software platform, IMPEL, is used to interface with the camera, post process and analyze the images, and save the data. Solar panel degradation rates and lifetime are the most important factors affecting the levelized cost of electricity from PV, and testing equipment plays a critical role in helping to solve degradation/performance problems and to optimize industrial processes. Improved software is critical to our mission.

o **A description of the work to be done:** Optimization of solar cell defect image quality

A variety of practical factors make it challenging to consistently obtain high quality images where all the cells in solar panel are in optimal focus. Some practical limitations include:

- Limited time to focus
- Low signal strength, causing Liveview video images to be noisy
- Short distances between the camera and the solar panel, making the distance between the camera and the solar panel much larger at the corners of the panel than in the center
- Testing of installed panels tilted at a steep angle from the camera such that the leading edge of the panels are much closer to the camera than the trailing edge

This project will attack the above challenges through improvements to the BrightSpot IMPEL platform including:

- Manipulation (e.g. summation) of video frames during Liveview focusing mode to obtain less noisy images where it is easier to judge optimal focus
- Automatic adjustment of camera focus and analysis of the summed images to find the optimal focus
- Acquiring 2 or more images of the panel at different focus settings, automatically segmenting the solar panel image into images of each individual solar cell, then building up a new solar panel composite image containing the best focused cell images. As an example, for a solar panel tilted away from the camera, the composite image may use the cells from the closest half of the panel imaged using focus setting #1 and use the cells from the further half of the panel imaged using focus setting #2.
- Allow fast manual categorization of defects within each segmented cell (e.g. through mouse actions and keyboard strokes). Apply approach to an existing dataset of electroluminescence images of hail damaged solar panels.

o **Any desired skill set for the students:** This project will rely heavily on image processing and GUI design

o **Preferred team size:** 3-5 people. Scope can be adjusted for team size.

o **Whether there is a potential to offer student(s) an internship at the end of the course:** Yes. BrightSpot's CTO is part of Cohort #1 of the NREL/Mines "West Gate" entrepreneurial program and will be conducting joint DOE-funded research with Mines researchers from Oct 2022 – Aug 2024. One topic of this research will be extending the analysis of the solar cell and solar panel defects from the manual mode to the automatic mode using machine learning techniques.

o **Location where work should be performed:** On campus, or from home. BrightSpot staff will interact via meetings on campus and through video calls.

o **Disclosures/IP:** Students will be required to sign an NDA (non-disclosure agreement) and to assign intellectual property rights on the software developed to BrightSpot