BrightSpot Automation

BrightSpot Automation Solar Panel Inspection Field Session 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. Testing of solar cells/panels for satellites is a particular growth area. 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 principal 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:** Exploration of Machine learning models for module/cell segmentation and day/night image pair generation with associated data labelling, data preprocessing and data postprocessing tasks.

1. Traditionally solar panel imaging in the field has been done at night to reduce noise light from the sun in captured images. Given both safety concerns and the practicality of imaging at night, we are looking to explore an approach to daytime imaging that will use a GAN machine learning model to generate a feature-enhanced image given the input of an unprocessed short exposure daytime image. The model may be trained on image pairs generated during realistic field conditions under sunlight and during optimized conditions in the dark, such that new inferences applied to daytime images can approach the quality of the ideal images. An example of a similar application is shown in the figure below.

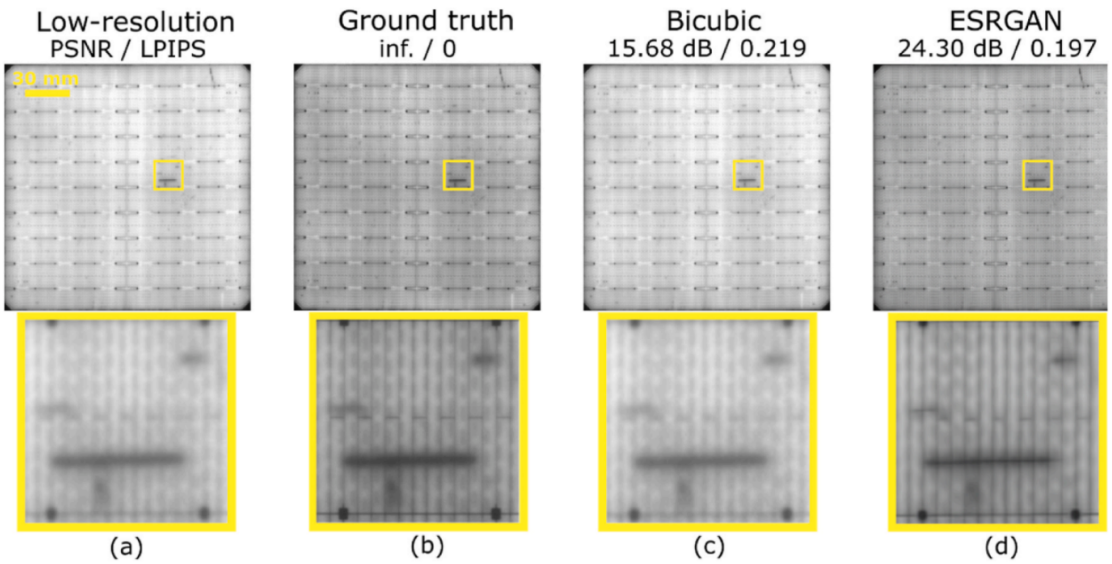

Fig. 6. A representative low-resolution image (a), the ground truth image (b), a bicubic-enhanced image (c), and an ESRGAN-enhanced image (d). Pixel counts for all the images range [0, 255].

2. Segmentation of solar panels from image backgrounds and segmentation of solar cells from an image of a solar panel have traditionally used unreliable and unscalable methods. An example of segmenting cells from a panel is shown below, using analytical methods. Recently, the scientific community proposed a machine learning-based approach as a viable alternative to these traditionally challenging tasks. We want to explore the segmentation approaches outlined in this literature while also considering approaches to postprocessing and derived figures of merit.

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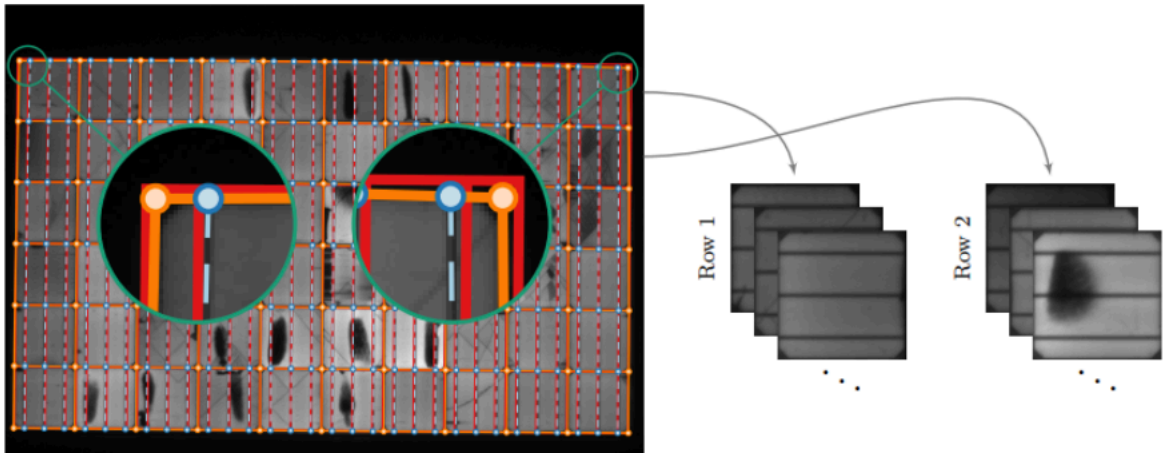
Segmentation of Photovoltaic Module Cells in Uncalibrated Electroluminescence Images



o **Any desired skill set for the students:** This project will rely heavily on machine learning and image processing. A prerequisite for the project is to have taken or be taking CSCI470 Intro to ML. It would also be valuable for at least one team member to have taken CSCI437 Computer Vision, and another to have taken CSCI303 Intro to Data Science.

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 is located nearby in Boulder.

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.