Line scan luminescence image simulation
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Quick Guide v1.0

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1. System Requirements

GridLS requires a 64-bit Windows operating system but runs as a standalone program, therefore no installation is required. Simply double click on the *GridLS* executable file within the program folder to begin.

2. Introduction

Welcome to *GridLS*: a little Python software package that enables the simulation of line scan photoluminescence (PL_{LS}) images in *Griddler 2.5 Pro*. Note that a licensed version of *Griddler 2.5 Pro* is required in order to use *GridLS*.

A large number of individual *Griddler* simulations are needed in order to generate a PL_{LS} image simulation. The position of the line illumination is varied in each individual simulation to emulate the process of PL_{LS} imaging. A theoretical imaging field of view is then extracted from each of the simulations and then combined to form the final PL_{LS} image (see Figure 1) [1].

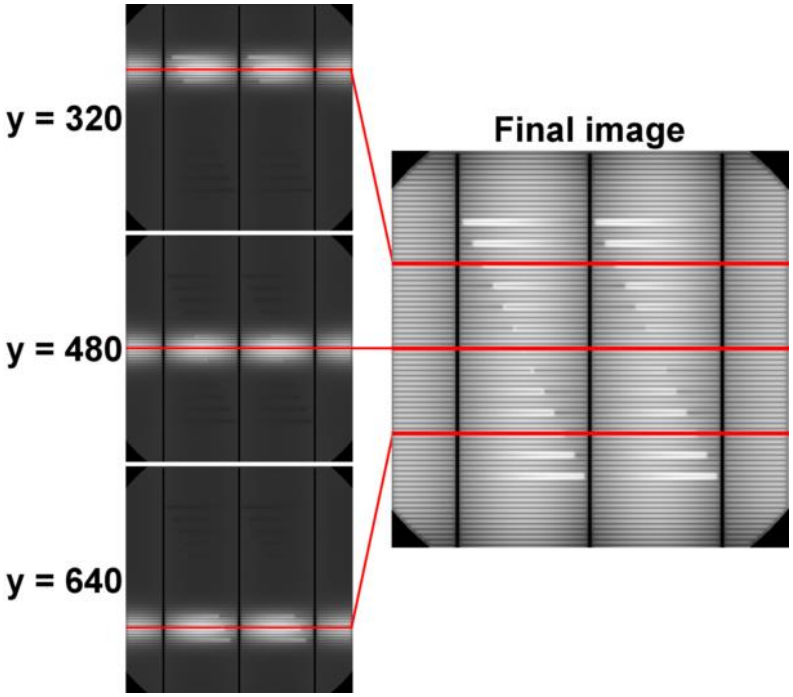

Figure 1: Diagram demonstrating the method of simulating a PL_{LS} image. (Left) A subset of the simulated images required to produce the final image. (Right) The final image constructed from the individual simulated images. The red lines represent the centre of the imaging field of view. Reproduced from [1].

The *GridLS* workflow is designed to perform this process very simply using only two steps, each initiated by a button in the user interface as shown in Figure 2:

1. Create Batch File, which organises both the simulation and output of the necessary images using *Griddler 2.5 Pro*
2. Analyse Simulations, which extracts the region required for PL_{LS} image combination from each individual simulated image

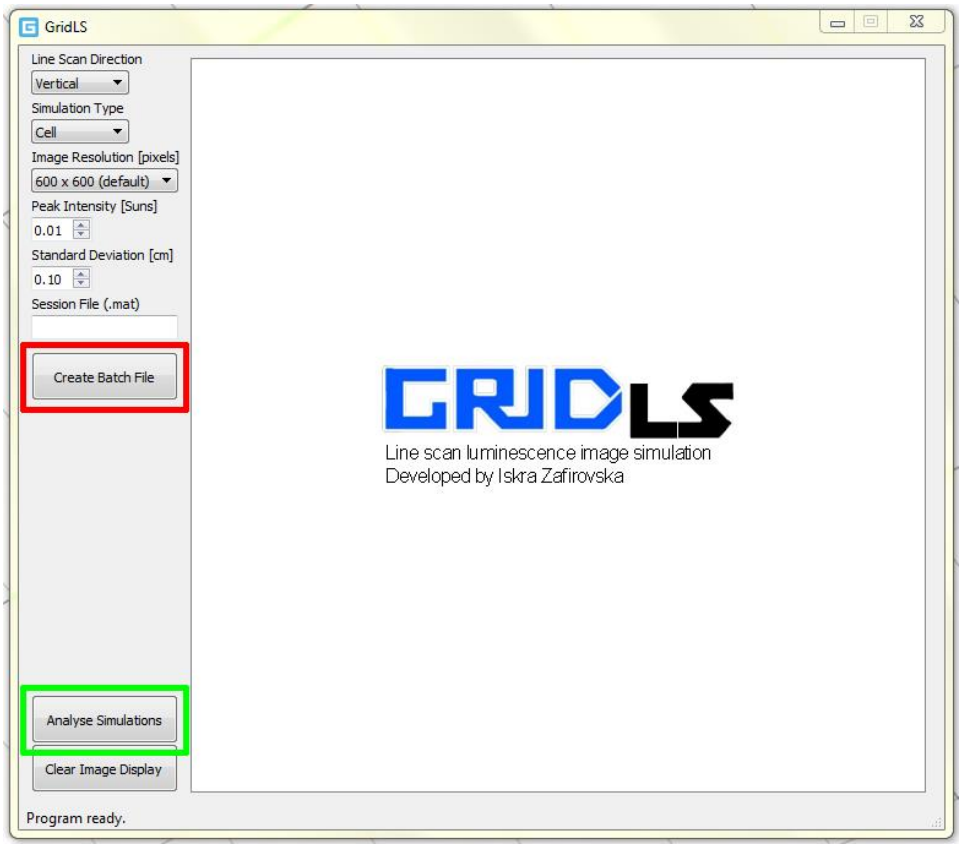

Figure 2: Screenshot of the *GridLS* user interface with the Create Batch File button bordered in red and the Analyse Simulations button bordered in green.

3. Create Batch File

GridLS makes use of the *Griddler 2.5 Pro* "Batch" option for this step, which executes a series of commands from a text script [2]. The "GAUSSIANLINELIGHTPATTERN" command is used to set the position and characteristics of the line illumination, which is defined as a Gaussian with a peak intensity and standard deviation as input by the user. A number of other simulation parameters are also input during this step:

1. Line Scan Direction, which determines whether the line illumination is oriented horizontally or vertically (see Figure 3)
2. Simulation Type, which determines whether the simulation is of a single cell or an interconnected cell within a module
3. Image Resolution, which determines the size of the simulated images in pixels
4. Session File, which defines the *Griddler 2.5 Pro* cell model that is used for the simulation

All simulation parameter inputs are located in the top left portion of the user interface as highlighted in Figure 4.

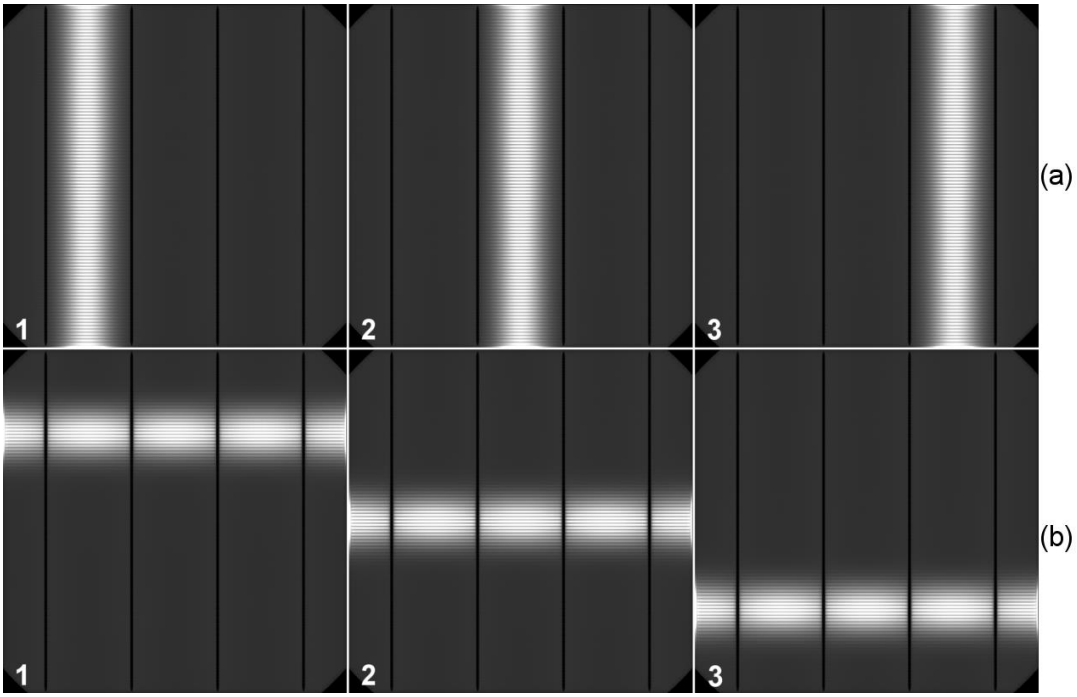

Figure 3: A subset of the simulated images required to produce PL_{LS} images with (a) horizontal and (b) vertical line scan direction. Reproduced from [1].

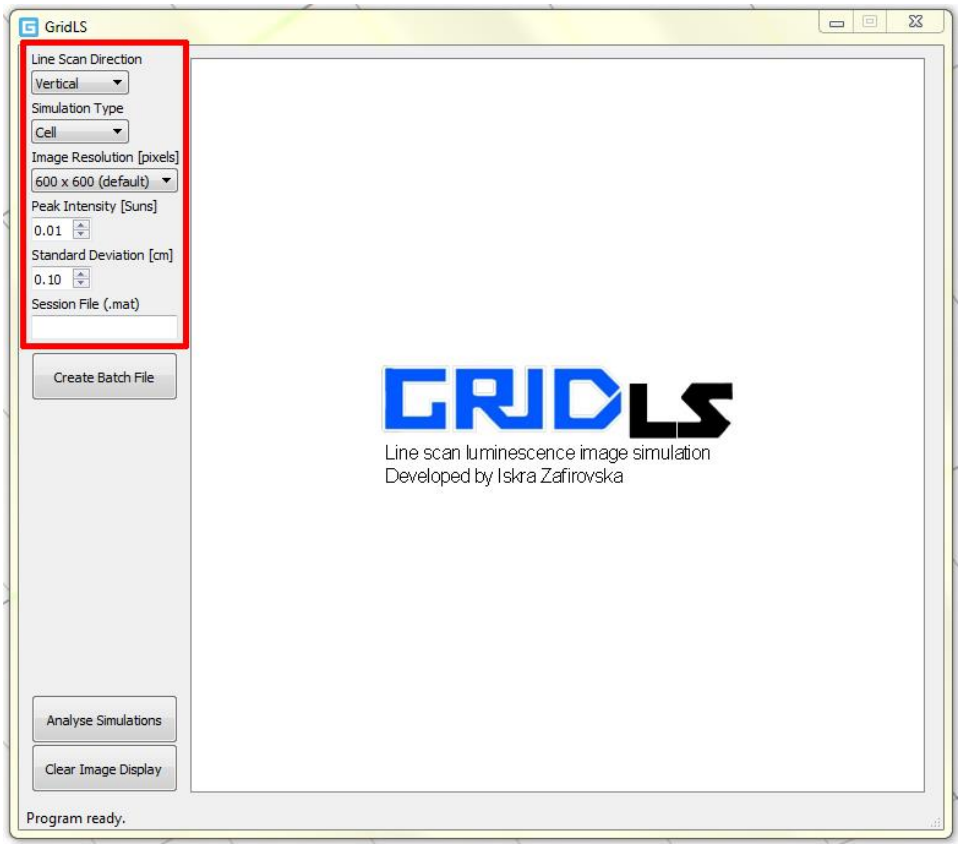

Figure 4: Screenshot of the *GridLS* user interface with the simulation parameter inputs for the Create Batch File step highlighted by a red box.

Upon clicking the Create Batch File button, the user is prompted to select a name and directory for the *Griddler* batch text file that is to be created. The user must

manually import this text file into *Griddler 2.5 Pro* as demonstrated in Figure 5, however following this the simulation and output of the necessary images is completely automated. *GridLS* also creates a directory with a “SimulationData” suffix to store the individual simulated images once they are output by *Griddler 2.5 Pro*, as well as an additional text file with a “Parameter” suffix that contains the values of the simulation parameter inputs.

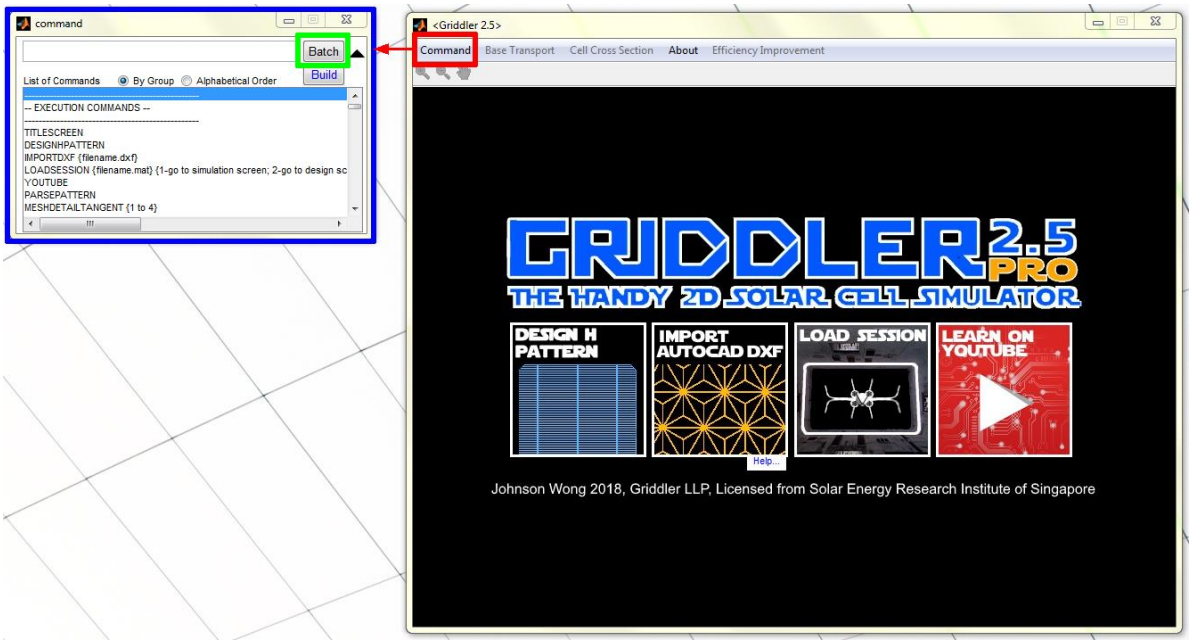

Figure 5: Screenshots of the *Griddler 2.5 Pro* user interface demonstrating the import of batch text files. Pressing “Command” in the menu bar (bordered in red) will call up the command window (bordered in blue), then pressing “Batch” in the command window (bordered in green) will bring up a file prompt for the batch text file.

4. Analyse Simulations

The Analyse Simulations step can only be performed once *Griddler 2.5 Pro* has output all of the individual simulated images. Upon clicking the Analyse Simulations button, the user is prompted to select the directory containing the individual simulated images and the simulation parameter text file (i.e. a directory with “SimulationData” as a suffix). Note that this step can take up to a few minutes, with longer times needed for larger image resolutions. Also note that there is a possibility that *GridLS* will not respond during this time, but once the step is completed the resulting PL_{LS} image will appear in the main window as shown in Figure 6. This PL_{LS} image is saved as a 32-bit TIF image in the directory that was selected by the user.

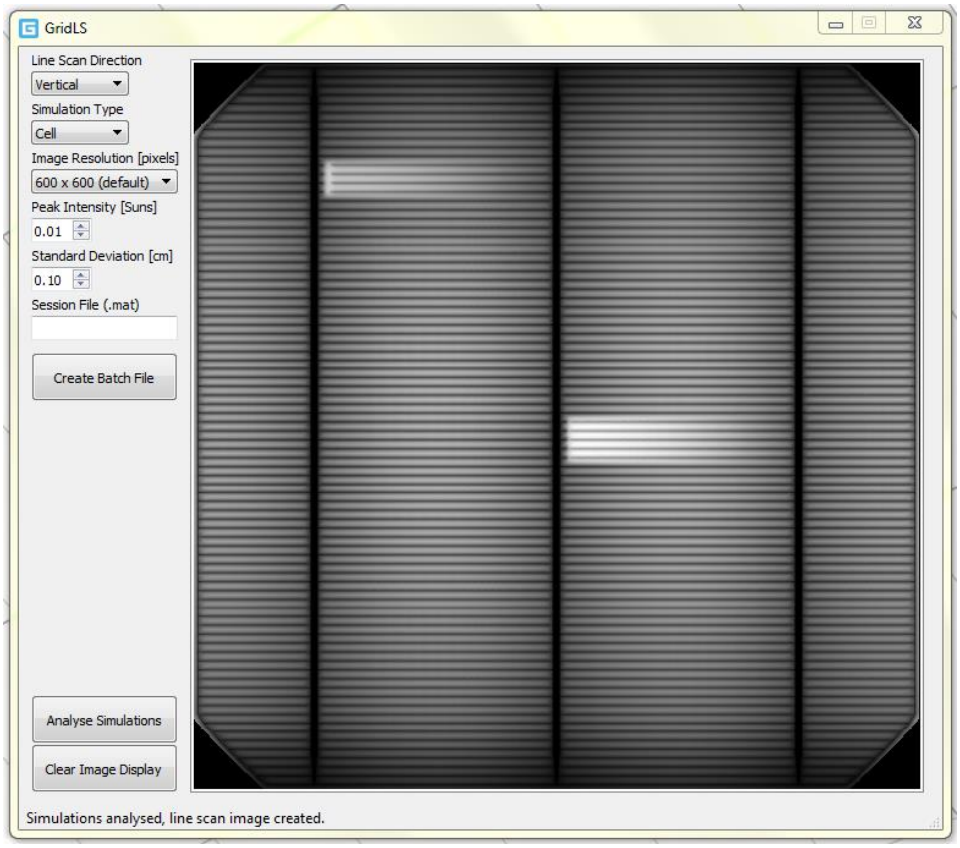

Figure 6: Screenshot of the *GridLS* user interface showing the PL_{LS} image result for a generic c-Si cell model containing multiple finger interruptions.

5. Conclusion

Thank you for using *GridLS*! This software was written solely for a PhD project, so the developer is excited to see its broader use. If you have any other questions, please don't hesitate to email the developer at iskrazaf@griddlersolar.com.

6. References

[1] I. Zafirovska, "Line scan photoluminescence and electroluminescence imaging of silicon solar cells and modules," Doctor of Philosophy, School of Photovoltaic and Renewable Energy Engineering, UNSW Sydney, 2019.

[2] J. Wong, "5.2.1 How to Use the Command Window," in *Griddler 2.5 User Manual*, 2020, pp. 63-66.