Integrating solar cells simulation software in an Undergraduate Engineering Class

performance. Solar Cell Capacitance Simulator (SCAPS) is a one-dimensional solar cell simulation program that has been developed by many researchers at the Department of Electronics and Information Systems (ELIS) of the University of Gent, Belgium. This user-friendly software can be used in teaching engineering undergraduate students about numerical simulations of photovoltaics. This paper will introduce the SCAPS software and outline a tutorial

Options for variable voltage bias, temperature and illumination
Can calculate concentrations, and currents at a given working point, J-

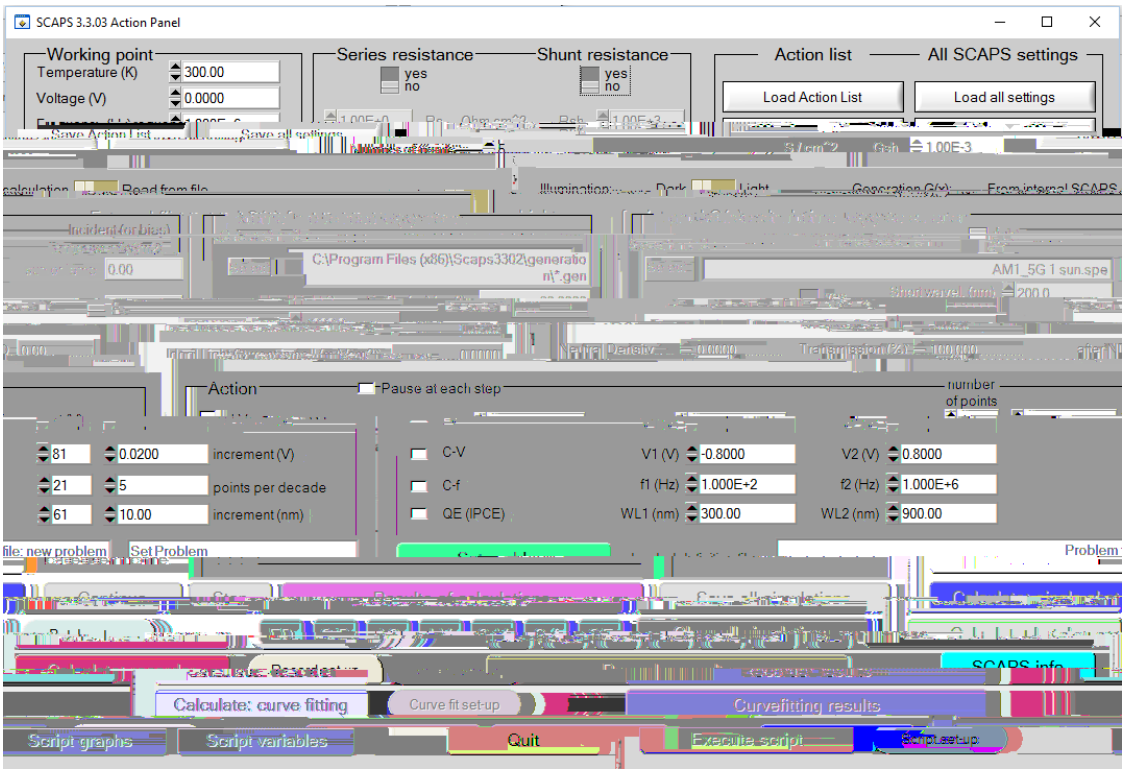

Figure 2: Action Panel of SCAPS 3.3.0.3.

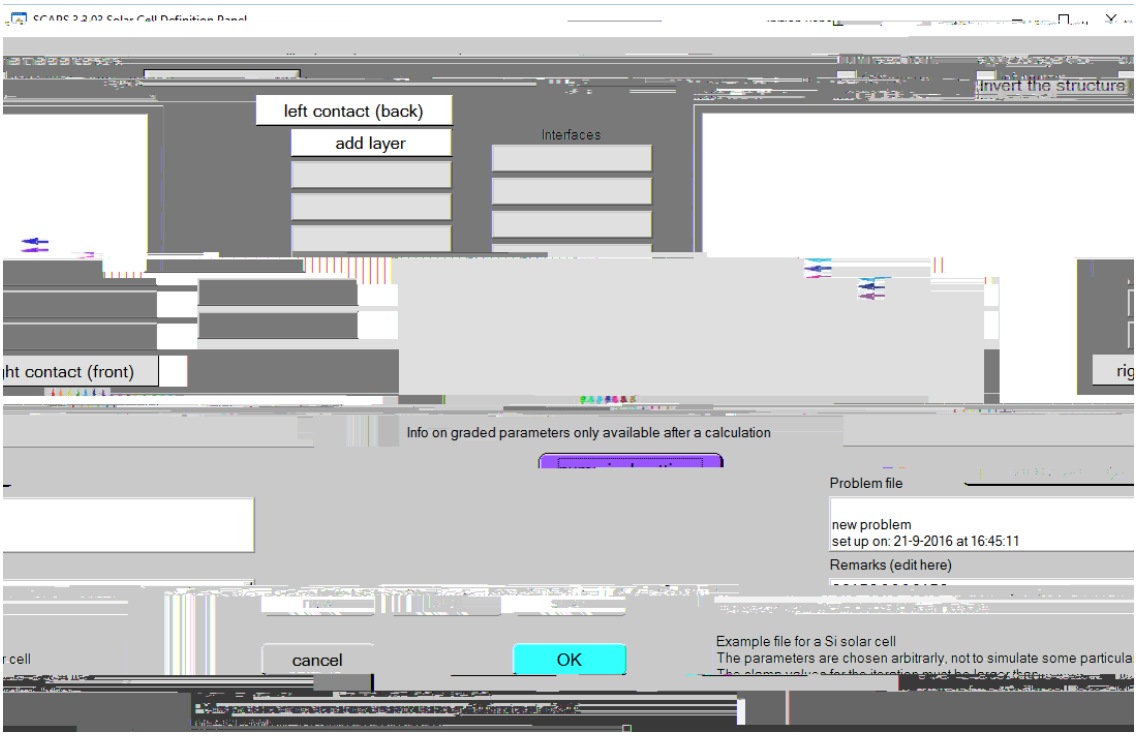

Figure 3: Solar Cell Definition Panel

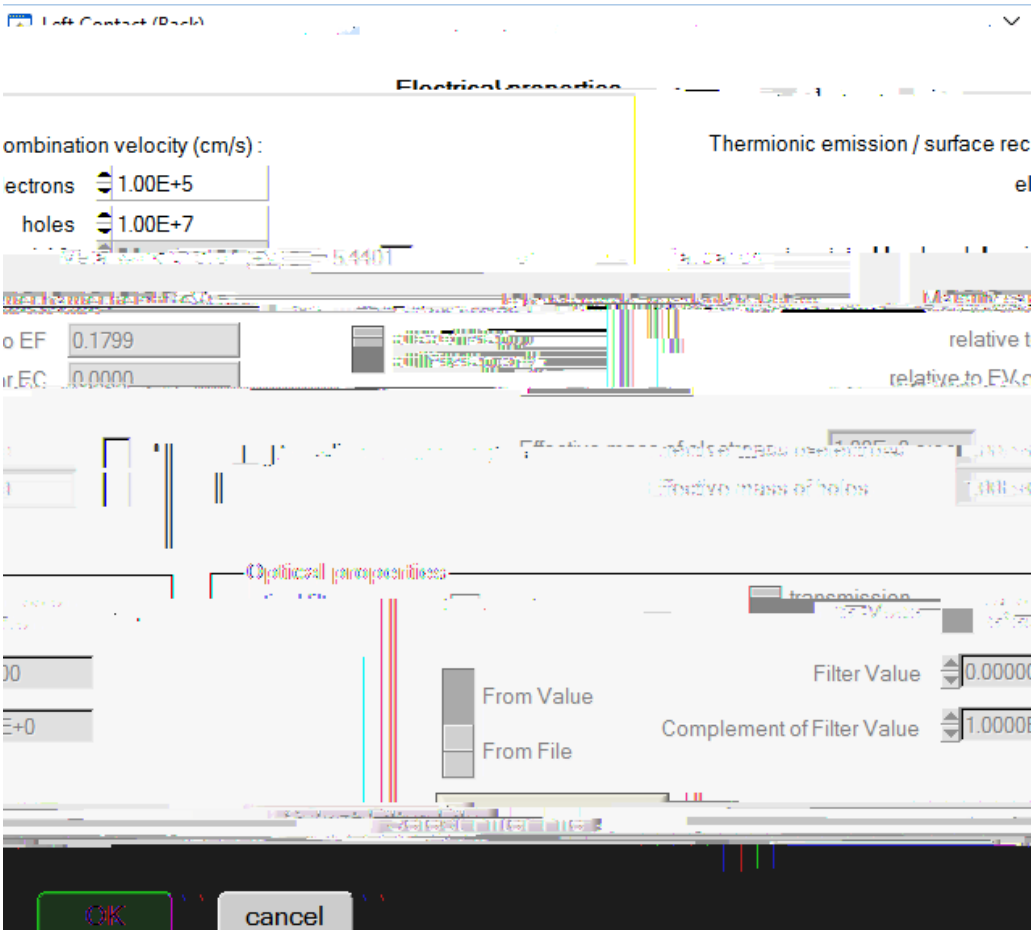

Figure 5: Window to edit electrical and optical properties for a contact.

4) Verify directions

Once the layers and contacts have been modified, the user should verify the direction of illumination and voltage application and set the current reference as consumer or generator. These options are towards the top right of the screen as shown in Figure 6.

Figure 6: Solar Cell Definition Panel for Si solar cell.

5) Save .def file

After every detail of the solar cell design has been verified, users should save the file as a .def file and click on OK to go back to the SCAPS Action Panel.

6) Set working point

Once the solar cell design has been loaded on SCAPS using the Set Problem button, the users

window open up with the band diagram, carrier density, current density and occupation probability of deep defects for electrons graph plots as shown in Figure 7 below.

Figure 7: Screenshot of Energy Bands Panel window for the Si cell design.

9) Results of Calculations

Users can either click on options (Gen- Rec, I-V) from the right side of the Energy Bands Panel window or exit the window to F O L F N R Q R S W L R Q V X Q G H U W K H ³5H button in yellow on the Action Panel window. Clicking on the I-V option opens the I- V panel. Users can also save graphs and export out of SCAPS as shown in figure 8 as JPEG, PNG or BMP files.

10) The user can also chose to simulate the performance of the solar cell under illumination E \ F O L F N L Q J ³/ L J K W ´ R Q W K H D F W L R Q S D Q H O 7 K H S U R J illumination which the user can use to calculate the efficiency of the solar cell. Figure 9 shows the I-V curve of the solar cell under illumination.

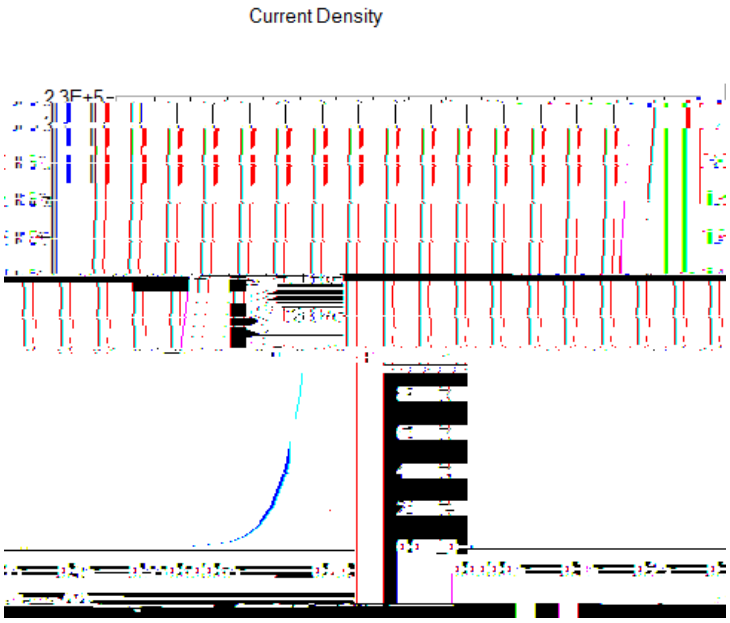

Figure 8: I-V curve of the solar cell under darkness exported from SCAPS.

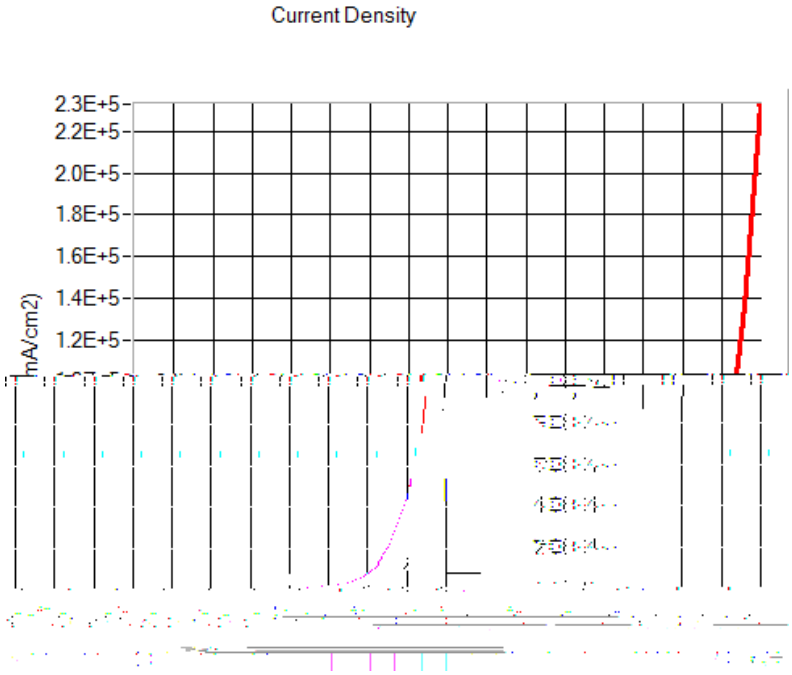

Figure 9: I-V curve of the solar cell under illumination exported from SCAPS.

Calculating efficiency

In order to calculate the efficiency of the solar cells the user can find the I-V curve under illumination and obtain from the curve the following parameters which are all shown in figure 9.

V_{oc}: is the open circuit voltage. It is the point at which the output current of the solar cell is equal to 0.

I_{sc}