

Calculation- and Visualization-Tool (CVT) for Partial Shading of Photovoltaic Systems

Partners:



EU PVSEC 2016, Munich, Germany, 20-24 June 2016

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Partial shading of photovoltaic systems can lead to disproportionate power losses. To visualize and precisely calculate the characteristic of a partial shaded PV system, a new simulation tool has been developed. Compared to existing simulation tools that address a PV module as a whole, our new CVT is able to provide quantifications at individual photovoltaic cell level.

Starting Position

Partial shading of photovoltaic systems can lead to disproportionate power losses. Due to the nonlinear behavior of the photovoltaic cells, the quantification of such power losses is challenging. Most simulation-tools to calculate power losses calculate the losses at photovoltaic module level rather than for individual photovoltaic cells. This is a major disadvantage because of the internal connections between the photovoltaic cells and the bypass diodes (see Figures 1a - b).

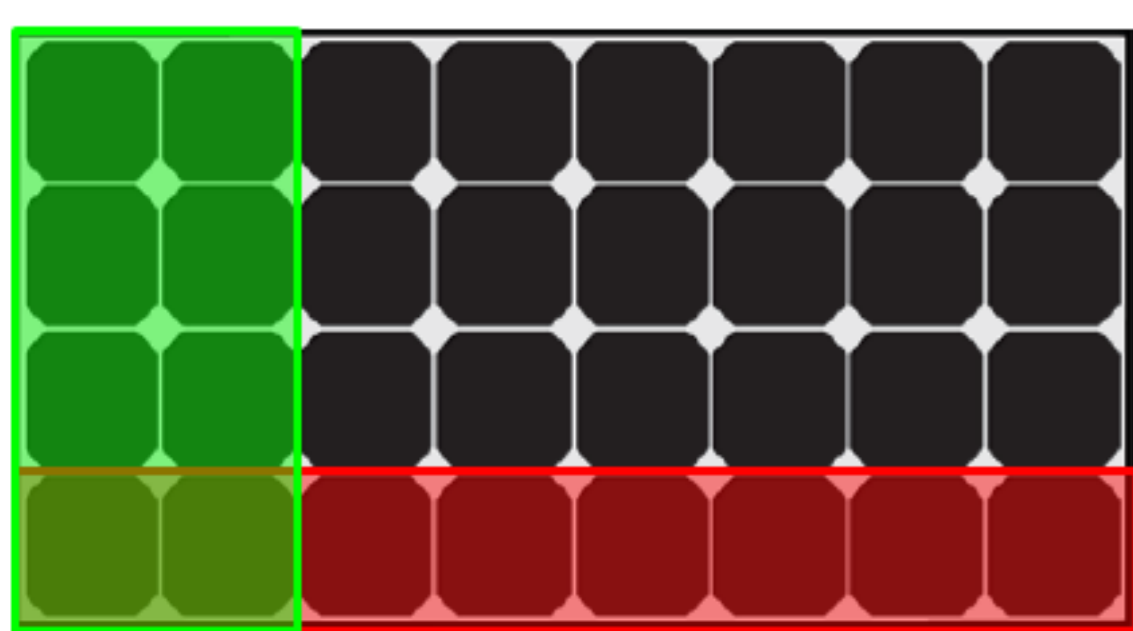


Fig. 1a: SunPower SPR-95 differently shaded

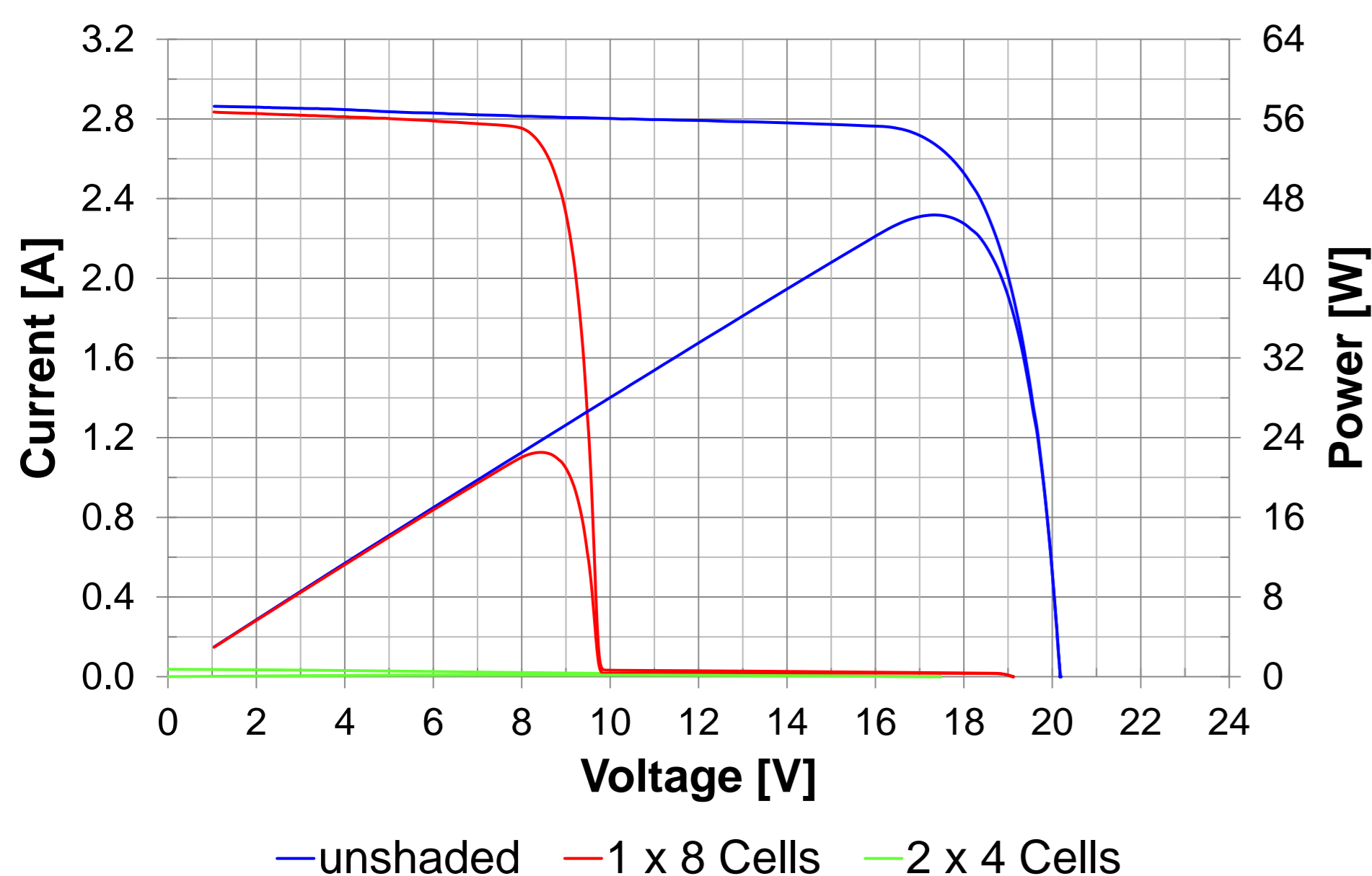


Fig. 1b: Characteristic of differently shaded modules

Program

The main task of this program is to create and calculate the photovoltaic system. The different tasks of the program are separated in different Tabs.

The first tab includes all important settings to create a photovoltaic system (see Fig. 2). Each module can be placed somewhere in this area. The shadow can be painted with different radiations. Also, the temperature can be defined for the whole photovoltaic system. The insolation of each photovoltaic cell will be calculated separately.

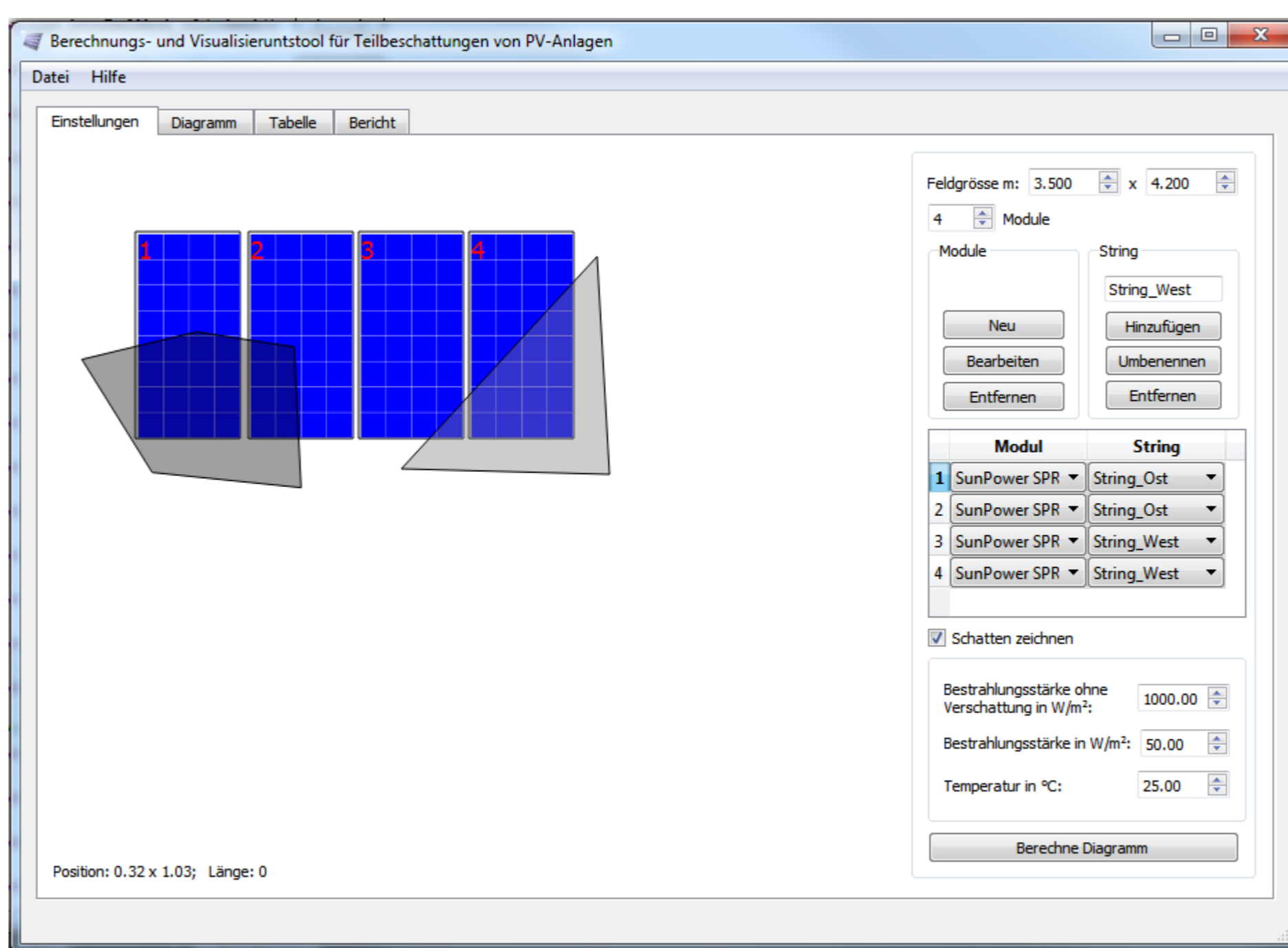


Fig. 2: Tab Settings

In the second tab (see Fig. 3), the characteristics can be included. It is possible to include the characteristic of the whole photovoltaic system, each module-string, each module, each cell-string and each photovoltaic cell.

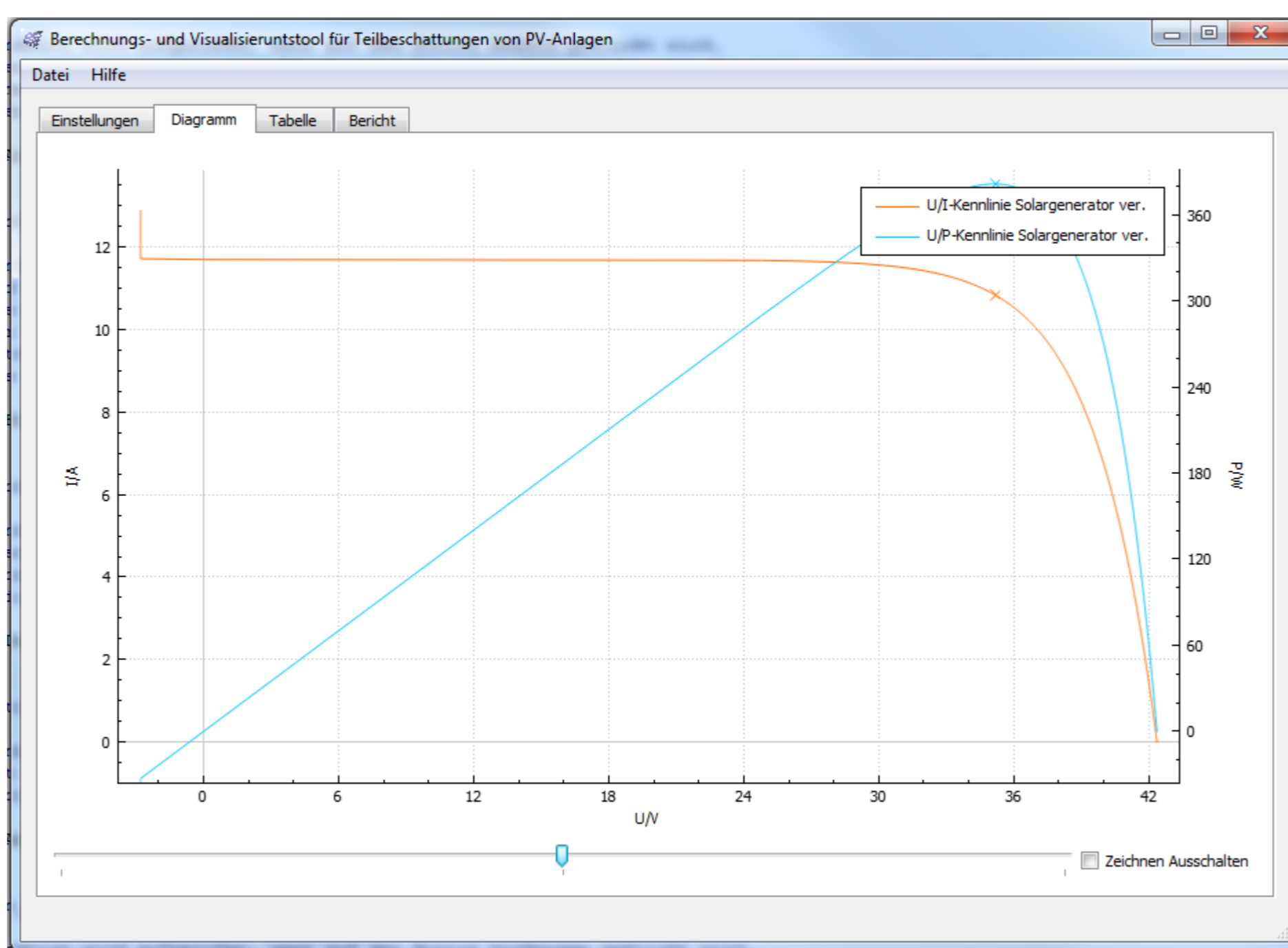


Fig. 3: Tab Diagram

The third tab (Figure 4) is a table containing the most important values, being: the maximum power point (MPP), the MPP-voltage, the MPP-current, the open circuit voltage and the short circuit current.

	UMPP	IMPP	PMPP	UOC	ISC
Solargenerator beschattet	35.1696	10.84	381.238	42.364	11.7
Solargenerator unbeschattet	35.1696	10.84	381.238	42.364	11.7
1. Modul: SunPower SPR-95 beschattet	17.5848	5.42	95.3096	21.182	5.85
1. Modul: SunPower SPR-95 unbeschattet	17.5848	5.42	95.3096	21.182	5.85
1. Zelle des 1. Moduls beschattet	0.549525	5.42	2.97842	0.661937	5.85
1. Zelle des 1. Moduls unbeschattet	0.549525	5.42	2.97842	0.661937	5.85

Fig. 4: Tab Table

Conclusions

The CVT is able to simulate any photovoltaic system; the condition required is that all simulated photovoltaic modules consist of crystalline cells and are in one plane. Different shadows can be defined and each module can be placed on a location within the drawing area in the tool. The shadow can be moved to a specified direction for a predetermined number of steps. The innovation of the CVT as compared to currently available models is the quantification of the characteristics at individual PV cell level rather than at PV module level. Among the planned extensions of the CVT are the implementation of various calculation models for the calculation of the solar cell and the bypass diode.

Further Information

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