

Title: Solar Cells and the Lambert W Function

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Abstract:

Solar cells are important for meeting the energy needs of our society. The relationship between the current and voltage produced by a solar cell is given by an implicit equation, involving both linear and exponential terms with both the current and voltage variables present. Solving the implicit solar cell equation requires time-consuming iterative solution techniques, which risk instability in the refinement algorithm.

Using the Lambert W function, the implicit current-voltage equation for solar cells can be solved explicitly for current as a function of voltage, or for voltage as a function of current. Explicit solutions can speed up computations, and do not have the risk that iterative refinements may produce instability in the outcome.

Solar cell calculations can involve arguments to the Lambert W function which are in excess of the magnitudes which can be represented in computer hardware floating point. For some purposes, the coding must be in Fortran or C and use hardware floating point arithmetic.

A coordinate change to log-log axes is the answer to this computational difficulty. The alternative function is just the Lambert W function in another guise. It is easy to calculate, even on a small computer, without any need to have a Lambert W function implementation available. For solar cell calculations the magnitudes of numbers are moderate, and the results are stable.