**Estimation of parameters for solar cells with S–shaped current–voltage characteristics using meta–heuristic algorithms**

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| Fig.S1. Fitting results (lines) for the simulated current-voltage characteristic (symbols). The values *I*01= 1.6⋅10-6 mA, *n*1= 1.92, *R*p1 = 190 Ω, *I*02 = 0.16 mA, *n*2= 1.92, *R*p2 =190 Ω, *R*s = 45 Ω, *I*ph = 8 mA were assumed under simulation. | | |

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| Fig.S2. Fitting results (lines) for the simulated current-voltage characteristic (symbols). The parameters values from Sec.2.2.2 were assumed under simulation. | | |

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| Fig.S2. Comparison of *I*01 value estimation by different algorithms on the I-V curve set. Circles represent the *I*01 values, which have been used in IV curve simulations, squares represent the median values, and stars represent the mean values. The colored regions correspond to the IQR. The lines only serve as guide to the eye. | | |

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| Fig.S2. Comparison of *n*1 value estimation by different algorithms on the I-V curve set. Circles represent the *n*1 values, which have been used in IV curve simulations, squares represent the median values, and stars represent the mean values. The colored regions correspond to the IQR. The lines only serve as guide to the eye. | | |

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| Fig.S2. Comparison of *R*p1 value estimation by different algorithms on the I-V curve set. Circles represent the *R*p1 values, which have been used in IV curve simulations, squares represent the median values, and stars represent the mean values. The colored regions correspond to the IQR. The lines only serve as guide to the eye. | | |

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| Fig.S2. Comparison of *I*02 value estimation by different algorithms on the I-V curve set. Circles represent the *I*02 values, which have been used in IV curve simulations, squares represent the median values, and stars represent the mean values. The colored regions correspond to the IQR. The lines only serve as guide to the eye. | | |

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| Fig.S2. Comparison of *n*2 value estimation by different algorithms on the I-V curve set. Circles represent the *n*2 values, which have been used in IV curve simulations, squares represent the median values, and stars represent the mean values. The colored regions correspond to the IQR. The lines only serve as guide to the eye. | | |

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| Fig.S2. Comparison of *R*p2 value estimation by different algorithms on the I-V curve set. Circles represent the *R*p2 values, which have been used in IV curve simulations, squares represent the median values, and stars represent the mean values. The colored regions correspond to the IQR. The lines only serve as guide to the eye. | | |

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| Fig.S2. Comparison of Rs value estimation by different algorithms on the I-V curve set. Circles represent the Rs values, which have been used in IV curve simulations, squares represent the median values, and stars represent the mean values. The colored regions correspond to the IQR. The lines only serve as guide to the eye. | | |