Combating Dust Storms with Wiper Mechanism

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Purpose: Exploration of Mars requires rovers powered by solar energy. Frequently occurring dust storms on Mars pose a major threat to the operation of the solar panel. Based on scientists' research, partial shading on a photovoltaic array, or covering part of a cell, one cell, or multiple cells, will significantly reduce the power output of the array. I sought out to improve the energy efficiency of a series-connected photovoltaic array with an engineered wiper mechanism that wipes dust off of the cells. Procedure: After I engineered the wiper mechanism, consisting of an aluminum extrusion frame with a wiper blade powered by a stepper motor and a pulley system, I determined the procedure where the photovoltaic array will convert the maximum energy in two different situations, a linear rate of dust falling and partial shading. I used homogeneous sand to simulate the dust on Mars. Conclusion: The results showed that the wiper mechanism significantly increased the maximum power output of the photovoltaic array, and therefore improved its energy efficiency as well. When 30g of sand was on the array, the percent decrease for the maximum power output was only 0.2978% after the wiper mechanism cleaned, compared to a 48.27% decrease without cleaning.