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Modeling Cascading Failures in the North American Power Grid
RYAN KINNEY, Dept. of Physics, University of Missouri-Rolla, Rolla, MO 65409, REKA ALBERT[1], Dept. of Physics and Huck Institute of Life Sciences, Pennsylvania State University, University Park, PA 16802, PAOLO CRUCITTI COLLABORATION[2], VITO LATORA COLLABORATION[3] — The North American power grid, one of the most complex technological networks in existence, permits long-distance power transmission as well as disturbance propagation. We model the grid using its actual topology and incorporate plausible assumptions about transmission substation load and overload. Our results indicate that a solitary substation loss can induce an overload cascade and reduce the grid's transmission efficiency by 25%. Examining the damage inflicted by single node removals, we find three universal behaviors which suggest that 40% of the transmission substations can induce an overload cascade when perturbed. While significant damage can result from a single node removal, subsequent removals have only incremental effects, which agree with the power grid's topological resilience to less than 1% node loss.

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