Providing Power

Even non-superheroes can flip a switch or press a button and presto: power on! That can seem like a miracle, but even more surprising is that the power you need is created at almost the same instant you flip the switch and often not at the power station nearest you. Maintaining the power grid—the highly connected network of power stations, transmission lines, and consumers—so that the flow of power for supply and demand is in precise balance takes quite a bit of mathematics. Differential equations, graph theory, and linear algebra help with the grid simulations that allow operators to monitor their systems and calculate system requirements. These simulations, involving millions of variables, can represent the grid as immediately as a few microseconds in the future, which allows operators to both sustain smooth performance and recover from any disruptions.

Researchers are planning to upgrade to a smarter grid, in which current consumers are also power producers who get up-to-date information on their power usage and cost. This will add more complexity to the grid. Because most of the new producers will be supplying power generated by variable sources, such as wind and sun, there will also be increased uncertainty in the system. Managing the additional complexity and unpredictability requires new hardware and new mathematical models to ensure that power needs, estimated to more than double by 2050, are still met.

Image: Earth's city lights. Data courtesy Marc Imhoff of NASA GSFC and Christopher Elvidge of NOAA NGDC. Image by Craig Mayhew and Robert Simmon, NASA GSFC.

For More Information: *Computational Methods for Electric Power Systems,* Second Edition, Mariesa L. Crow, 2009.

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