Simulation software optimizes networks

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By the year 2020, thousands of kilometers of new grids will be operating in Germany to permit even more extensive use of power from renewable sources. However, these new "smart grids" also come with increased complexity, costs and vulnerability. Fraunhofer researchers developed new software that can be used to analyze and optimize transport grids for electricity, gas and water even at the planning stage, based on numerical simulations.

Almost every winter, news about reduced gas deliveries from Siberia to Europe makes the headlines. Regardless of the political reasons for a shortage, operating pipelines in severe winters is very challenging. Because if the gas in the pipes cools off too sharply, it partly liquefies and can no longer flow as swiftly. To maintain the temperature of the gases within a certain range consistently, a complex system of compressors, pre-heaters, coolers and other elements is needed. Systems operators constantly monitor the condition of their pipelines and plan ahead for reactions to potential temperature and pressure changes.

This new simulation software, called MYNTS (Multiphysical Network Simulation Framework), helps with the operation and planning of such complex networks, and was jointly developed by the Fraunhofer Institute for Algorithms and Scientific Computing SCAI and the team under mathematics professor Dr. Caren Tischendorf of the University of Cologne. The program models the transport grids as systems of differential-algebraic equations. Thus through numerical simulations, the grids can be flexibly analyzed and better planned. Specifically, the simulation immediately demonstrates the effects of changes in various

factors. Using MYNTS, for example, one can calculate how temperature fluctuations alter the flow measurements, or how the failure of subnetworks influences the other grid components.

Flexible planning of gas, power and water grids

"Regardless of dealing with transport systems for gas, power, water or electrical circuits, their simulation always traces back to the same numerical core," explains department head Dr. Tanja Clees. Nonetheless, because each field of application also has its unique features, specialized versions of the software are available for various utilities. With MYNTS for simulation of gas transport systems, for example, a user can set up and control his or her own subnetworks or add compressor stations and mixing chambers. In order to accelerate simulation computations, the software runs on computers with multiple processors.

This software is also of interest for smart grids, construction of which over the next few years is being promoted by the German government. Because intelligent networking and controlling of electricity producers, storage facilities, electricity consumers and network resources within supply networks are considered to be among the greatest economic and environmental technology challenges.

For example: if bulk consumers could be controlled more efficiently, and power supply adjusted to match demand at different times, then consumption peaks could be capped, and the consumption of electric energy equalized to supply. Such bulk consumers include water companies. One study shows that in industrialized nations, roughly three percent of the total electrical power consumed is used by water companies – specifically for pumps. Intelligent control of the network would have major economic potential: even minor incremental savings make a major contribution that benefits the environment.

Clees and her team have already been able to prove the successful utilization of MYNTS in several research projects; now the first commercial projects begin. Negotiations for licensing of the software are currently under way with companies in various industries.

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