



SOFTWARE MYNTS OPTIMIZES TRANSPORT NETWORKS FOR ELECTRICITY, GAS AND WATER

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In the future, thousands of kilometers of new grids are to be built in Germany in order to use more electricity from renewable energies. The new “intelligent networks” (smart grids) increase complexity, costs and vulnerability. Fraunhofer SCAI has developed software that can be used to analyze and optimize transport networks for electricity, gas and water by means of numerical simulations right from the planning stage. This makes conversion and expansion more flexible for network operators, saves energy and expenditure and also increases security.

Efficient transport networks for gas, electricity and water are of great importance. Studies show that around three percent of the total electrical energy consumed is used for water supply – mainly for pumps. Optimized network control would therefore have great economic potential: Even small percentage savings

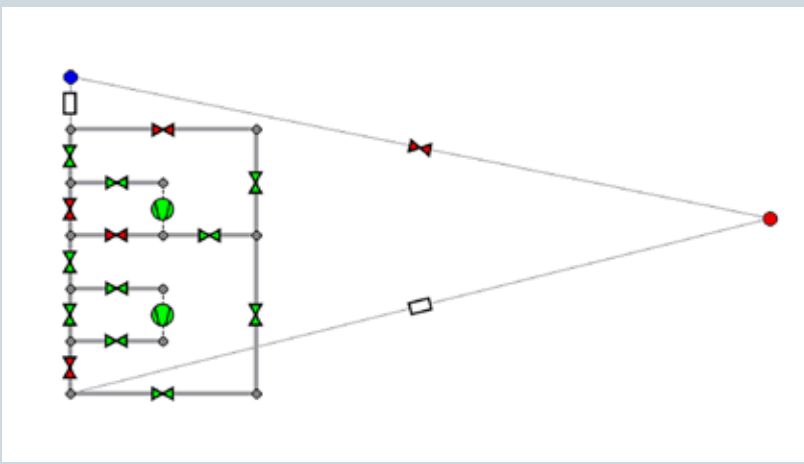
make a big contribution to the environment and help to cut costs.

Better network planning and optimized management save energy and costs

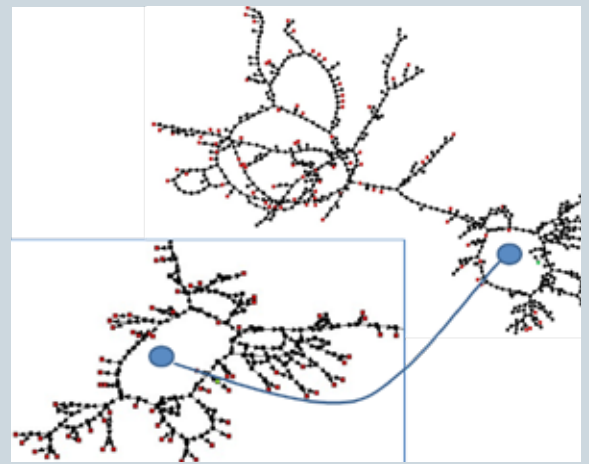
Another example is the massive expansion and restructuring of the electricity grids in Germany to cope with the switch to renewable energies.

But the software is also interesting with regard to smart grids, the expansion of which is being promoted by the German government. After all, the intelligent networking and control of power generators, storage facilities, consumers and network operating resources is one of the greatest economic and environmental challenges. Local solutions can also make an important contribution: improved time management and savings, especially for





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1 Schematic representation of a compressor station as a reusable subnet for MYNTS-Gas.

2 Graphical visualization of two networks, which are matched by net'O'graph ("graph matching").

energy-intensive companies, could help to cut consumption peaks and bring electricity and gas consumption into line with the supply. However, this would increase complexity and costs.

Flexible planning of gas, electricity and water networks

The simulation software MYNTS (Multi-physical Network Simulator), developed by Fraunhofer SCAI in collaboration with the University of Cologne, helps to operate and plan complex networks. The program models the networks as a system

of algebra-differential equations. They can be flexibly analyzed and better planned using numerical simulation. Above all, the simulation immediately shows the effect of changes in various factors. For example, MYNTS can be used to calculate how temperature fluctuations change the flow rates and how the failure of subnetworks affects the other network components.

MYNTS takes advantage of the fact that the simulation of gas, electricity and water transport networks as well as the simulation of electrical circuits is based on the same numerical core. Nevertheless, each field of application has its own special features. The software is therefore available in special versions for different fields. Combinations are also possible, for example for the investigation of power-to-gas scenarios. For the simulation of gas transport networks, MYNTS allows the user to create and control his own subnetworks,

for example for compressor stations or mixing chambers.

MYNTS is developed in close cooperation with industrial users (e.g. Open Grid Europe, Essen). In combination with the software tools "net'O'graph" and "DesParO", also developed by SCAI, tasks for graph analysis and comparison, statistical analysis and parametric optimization tasks can be performed.

New developments in MYNTS:

- templates (programmable assemblies) for reusable subnetworks
- new solver kernel
- more flexible modeling
- sector coupling (gas-power-heat)
- network viewer based on Open Street Map
- hydrogen content up to 100 percent (modeling according to GERG-2008)

Software	Tasks	Special Functions	Availability
MYNTS → www.scai.fraunhofer.de/mynts	Simulation and visualization	User-programmable subnetworks, user-defined elements, open modeling, steady-state as well as time-dependent computations, efficient math kernels exploiting multiple cores	MYNTS-Gas: Windows, Linux MYNTS-Circuit: Linux, further on request MYNTS-Water: for research purposes MYNTS-Electricity: under development
net'O'graph → www.scai.fraunhofer.de/netograph	Network and graph analysis, matching, layout	Extensive C++-library for analysis and optimization, support for different formats; efficient routines for large networks	Windows, further on request
DesParO → www.scai.fraunhofer.de/desparo	Metamodeling, parametric analysis and optimization	Efficient interpolation by means of response surfaces with adaptive model building, Pareto optimization, extensive statistical analyses, Python API	Windows and Linux