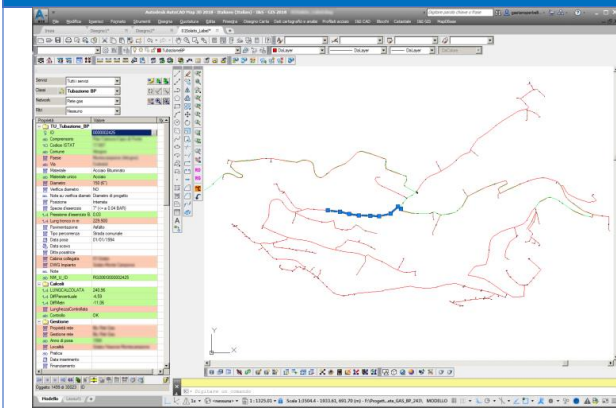


Development of a C++ code for the simulation of pressurized pipe networks for gas transport and distribution.

Project summary



Client:	I&S srl
Partner:	-
Year:	2016-2017
Service:	Scientific Software Development
Sector:	Industrial Engineering
Project in numbers:	10000+ lines of code
Coding language:	C++, Fortran 90, Open-MP
Other details:	NetGas is integrated in a CAD/GIS system developed by I&S and based on AutoCAD/AutoCAD LT/ZWCAD (www.ies.it)

Abstract

The project aims to develop an efficient standalone library (NetGas) for the simulation of the gas flow within a pressurized pipe networks. The library can be used to simulate distribution system of methane (low and medium pressure), transport system of methane (high pressure) and distribution of technical gases (carbon dioxide, nitrogen, acetylene, ...).

In particular, the NetGas library is equipped with the M3E_LinSolver, a state-of-art iterative linear solver for large sparse matrix, which allows to solve in few seconds very large networks up to hundreds of thousands of nodes/pipes.

The NetGas library has been developed to incorporate an advanced simulation model into a CAD/GIS system based on the AutoCAD technology. This environment is very popular among network designers operating in small and big distribution companies.

Project description

NetGas is a standalone library (DLL) that performs extended period simulation of the gas flow within pressurized pipe networks. The simulation allows to predict the behavior of gas network systems under different usage conditions. Such predictions can be effectively used to guide decisions regarding the design and operation of the real system.

A network system consists of pipes, nodes (pipe junctions), pressure-reduction cabins, compression cabins and valves. NetGas tracks the flow of gas in each pipe and the pressure at each node throughout the network during a simulation period comprised of multiple time steps.

NetGas contains a state-of-the-art gas analysis engine that includes the following capabilities:

- It computes the drop of pressure by means of Fergusson and Renouard formulas.
- It computes the compressibility coefficient z by means of Redlich-Kwong equation.
- It computes the physical properties of the gas as a function of the composition, temperature and pressure.
- It places no limit on the size of the network that can be analyzed.
- It models various types of valves including shutoff, check, pressure regulating, and flow control valves.
- It considers multiple demand categories at nodes, each with its own pattern of time variation.
- It can be used for distribution system of methane (low and medium pressure), transport system of methane (high pressure) and distribution of technical gases (carbon dioxide, nitrogen, acetylene, ...)

In particular, the NetGas library is equipped with the M3E_LinSolver, a state-of-the-art iterative linear solver for large sparse matrix, which allows to solve in few seconds very large networks up to hundreds of thousands of nodes/pipes.

Project outcome

The result of the project is a standalone software library (DLL) which can be used in conjunction with a graphical engine (for example a GIS or CAD software).

The library can be used for analysis and design of existent and new pipelines.