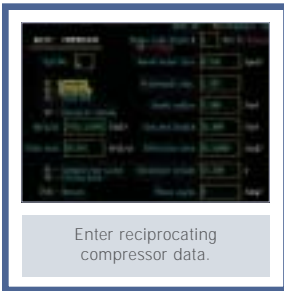


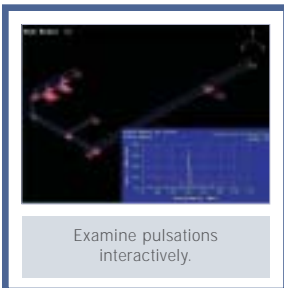
## An interactive simulation program for the analysis of fluid flow in piping networks



Bentley® PULS is an interactive simulation program for the dynamic response analysis of fluid flow under steady-state pulsating flow conditions in piping networks. PULS is based on one-dimensional plane wave theory, and employs an efficient transfer matrix approach. PULS is ideal for predicting pressure pulsation levels and acoustic shaking forces. The program may be used for solving performance problems caused by reciprocating equipment or flow generated sources in piping and pipeline systems, and in compressor, pump, control valve and meter stations. Unlike older analog computing methods, PULS provides a state-of-the-art digital solution. The technology is based on methods developed and proven under a multi-million dollar research program at Nova Corporation of Alberta.

### Easy-to-Use Interface

PULS has a sophisticated, user-friendly, menu-driven interface for quickly developing system models while minimizing data entry. Model verification is rapid, due to extensive graphics that highlight model features at any point in the model building process. PULS performs consistency checks to identify errors and supports English (imperial) or SI units. Customized units can also be specified.



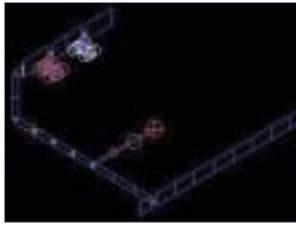
### System Model

Nodes-defining system geometry are assigned with inter-connecting elements. The elements include components such as pipes, tees, reducers, valves and orifice plates. Element transfer matrices are integrated into an overall system matrix composed of linear equations with complex coefficients and variables. The variables include RMS values of pulsating pressure and volume flow velocity at each node. A sparse variant of Gaussian elimination for the solution of unsymmetrical equations solves for the results. The transfer matrices are based on a comprehensive body of semi-empirical equations and data acquired through a rigorous, experimental testing program conducted at the Nova facilities and the University of Calgary. Gas properties are calculated using Benedict-Webb-Rubin-Starling (BWRS), Soave-Redlich-Kwong (SRK) or Peng-Robinson (PR) equations of state. PULS also accepts user-defined fluid properties.

### Post Processing

PULS provides both batch output and interactive plotting in which acoustic resonance shapes can be animated. Key results include pulsation ratios based on API 618 guidelines, spectral plots of pulsation pressures, volume flow velocities, impedance, shaking forces and cylinder pressure-volume trace card (PV card). Shaking forces can be automatically transferred into Bentley® AutoPIPE® in order to calculate dynamic piping responses.

## BENTLEY PULS AT-A-GLANCE



Animate pulsations and resonance.

### Easy to use

- Easy-to-use, menu-driven PC program
- Reduction of expensive consulting fees
- Ability to model both gas and liquid systems
- Fast transfer matrix solution for results in less than a minute vs. several hours with time domain methods

### Featured Elements

- Elements include pipes, volume, pressure drop, tees, orifice plates and valves
- Pipe elements include damping due to viscous, thermal and frictional effects
- Pulsation sources include pressure, volume flow velocity, orifice plate, ball or globe valve, reciprocating compressor, and reciprocating pump

### Modeling/Analysis Features

- Ability to check pulsations against API 618 guidelines
- Ability to predict and eliminate problems at the design stage
- Model archiving for "what-if" analysis in retrofit work
- Flow induced vibrations
- Ability to import models from AutoCAD-based AutoPLANT® software, and from AutoPIPE pipe stress analysis program
- Ideal for troubleshooting vibration problems and for acoustic filter design
- Automatic generation of gas properties for common natural gas mixtures

## BENTLEY PULS SYSTEM REQUIREMENTS

- Processor:  
Pentium II 400mHz
- Operating System:  
Windows 98, Windows NT 4.0  
SP6, 2000
- Memory:  
128MB RAM
- Disk Space:  
10 MB (20 MB recommended)

## ABOUT BENTLEY

Bentley Systems, Incorporated provides software for the lifecycle of the world's infrastructure. The company's comprehensive portfolio for the building, plant, civil, and geospatial vertical markets spans architecture, engineering, construction (AEC) and operations. With 2003 revenues reaching \$260 million, Bentley is the leading provider of AEC software to the Engineering News-Record Design 500 and major owner-operators.

For more information, visit [www.bentley.com](http://www.bentley.com) or call 1-800-BENTLEY.

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