DHI CASE STORY

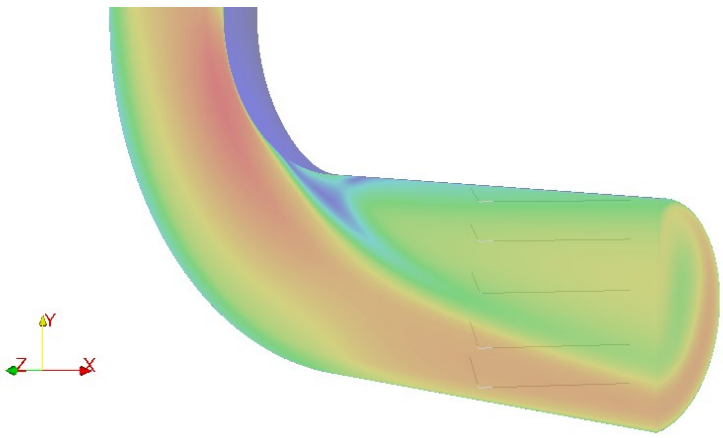
LISTENING TO THE WATER

Using acoustic signals to improve flow measurements

Placing a flow meter close to a flow obstruction in a pipe (such as downstream of an elbow or T-junction) often results in inaccurate flow rate measurements. Unlike a straight pipe, these areas of pipes have more complex shapes, resulting in high measurement errors. As such, the placement of flow meter devices is currently restricted to positions with an undisturbed flow field. However, such positions can be difficult to find. To address this problem, we worked with HydroVision GmbH to develop a new acoustic flow meter using Computational Fluid Dynamics (CFD) modelling. With the help of acoustic signals, the new device can deliver accurate flow measurements. Due to a unique correction algorithm, it does so even in disturbed flow fields. This allows for more flexibility when constructing pipe systems as long, straight sections are no longer required. Customisable, it can be adapted to the specific needs of the user. In addition, it allows for real-time processing of information, permitting users to determine exactly how much water is flowing through their pipes.

LIMITED APPLICATION OF CONVENTIONAL FLOW METERS

Measuring water discharge in conventional pipes can pose very specific challenges. Currently, measurement devices in pipes require a straight section with a length at least 10-50 times the pipe diameter. This is necessary to have a symmetric fluid velocity profile in the pipe. It is only under these conditions that flow meter manufacturers guarantee high measurement accuracy.



Schematic view on the flow velocities downstream of a 90° elbow

SUMMARY

CLIENT

HydroVision GmbH

CHALLENGE

- Inability to obtain accurate flow measurements in pipe networks that do not have long, straight sections
- Increased cost involved in constructing long, straight sections in pipe networks due to the limits of existing current flow meter devices

SOLUTION

Using Computational Fluid Dynamics (CFD) modelling to develop a flow meter capable of measuring water flow in pipes with complicated pipe geometries

VALUE

- Enables industries (that require accuracy in water flow measurements) to gain precise flow measurements in areas close to flow obstructions
- Increases flexibility in terms of controlling pipe flow
- Allows for more freedom when it comes to pipe designs, saving money in the process

LOCATION / COUNTRY

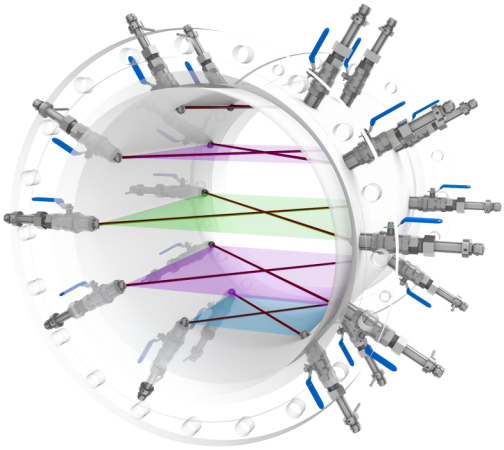
Singapore and Germany

Many industries, such as water suppliers, need to know exactly how much water goes through their pipes. Because of the limits of traditional flow meters, pipe systems are often constructed with long, straight sections. Space constrains, however, sometimes make this very difficult or require additional resource investment. In addition, existing pipes must occasionally be modified or new pipes constructed in order to gather accurate data from flow meters. This can be an expensive process.

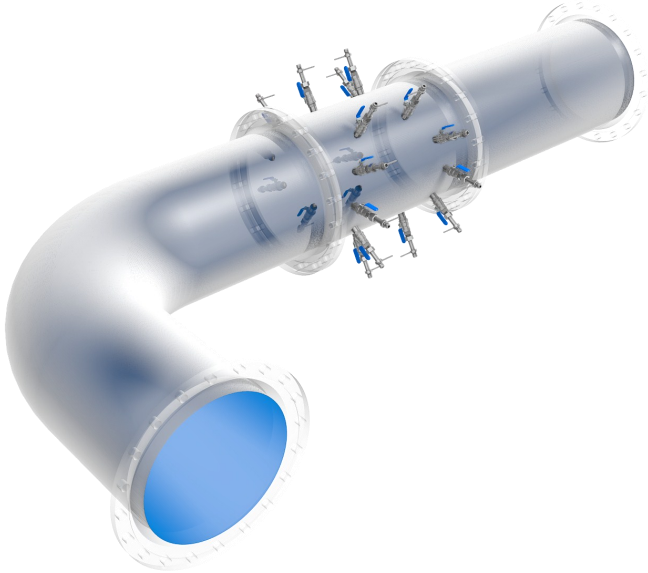
MEASURING DISTURBED FLOW FIELDS

In sections of a pipe that are not straight, such as at elbows, T -junctions and valves, the flow field is disturbed and therefor asymmetric. Using our strong CFD simulation specialists, we worked with HydroVision GmbH to develop a new acoustic flow meter device capable of accounting for these disturbed flow fields.

Our experts in fluid dynamics, numerical modelling and mechanical & electrical engineering in Singapore and Germany used CFD to assess and analyse various kinds of disturbed flow fields. We included this 'disturbance' information in the measurement signal processing. We then used this data to develop an acoustic flow meter that can be used in such disturbed flow fields. It works by sending acoustic signals on different paths through the fluid. The fluid's flow velocity is then calculated based on the time taken by these signals to travel from the sender to the receiver.



Acoustic signal paths in ReVision, here arranged in five layers



ReVision flow meter in a pipe system near a 90° elbow.

MORE ACCURATE MEASUREMENTS AT MORE LOCATIONS

Because of this device, a long, straight section of pipe is no longer necessary to ascertain flow measurements. The acoustic flow meter can be installed almost anywhere in the conduit. This unique device can determine exact flow velocities just behind flow obstructions. This allows for accurate measurements at previously impossible pipe locations.

The acoustic flow meter gives users more flexibility when it comes to controlling pipe flow. As such, pipe systems can be designed with only the transportation of fluid from point A to B in mind, saving users a considerable amount of money. Additionally, the device is customisable. This allows for real-time processing and can be tailored to meet individual needs in terms of accuracy and special flow conditions.

CLIENT TESTIMONIAL

> *The selected DHI CFD experts are highly skilled. Quite from the beginning, very intensive and detailed discussion could be initiated and the task executed. The DHI colleagues have shown a straightforward project execution, sticking to the timeline and delivering the expected results.*
> *Jürgen Skripalle—General Manager—Hydrovision GmbH*

Contact: Stefan Leschka – sle@dhigroup.com
For more information visit: www.dhigroup.com