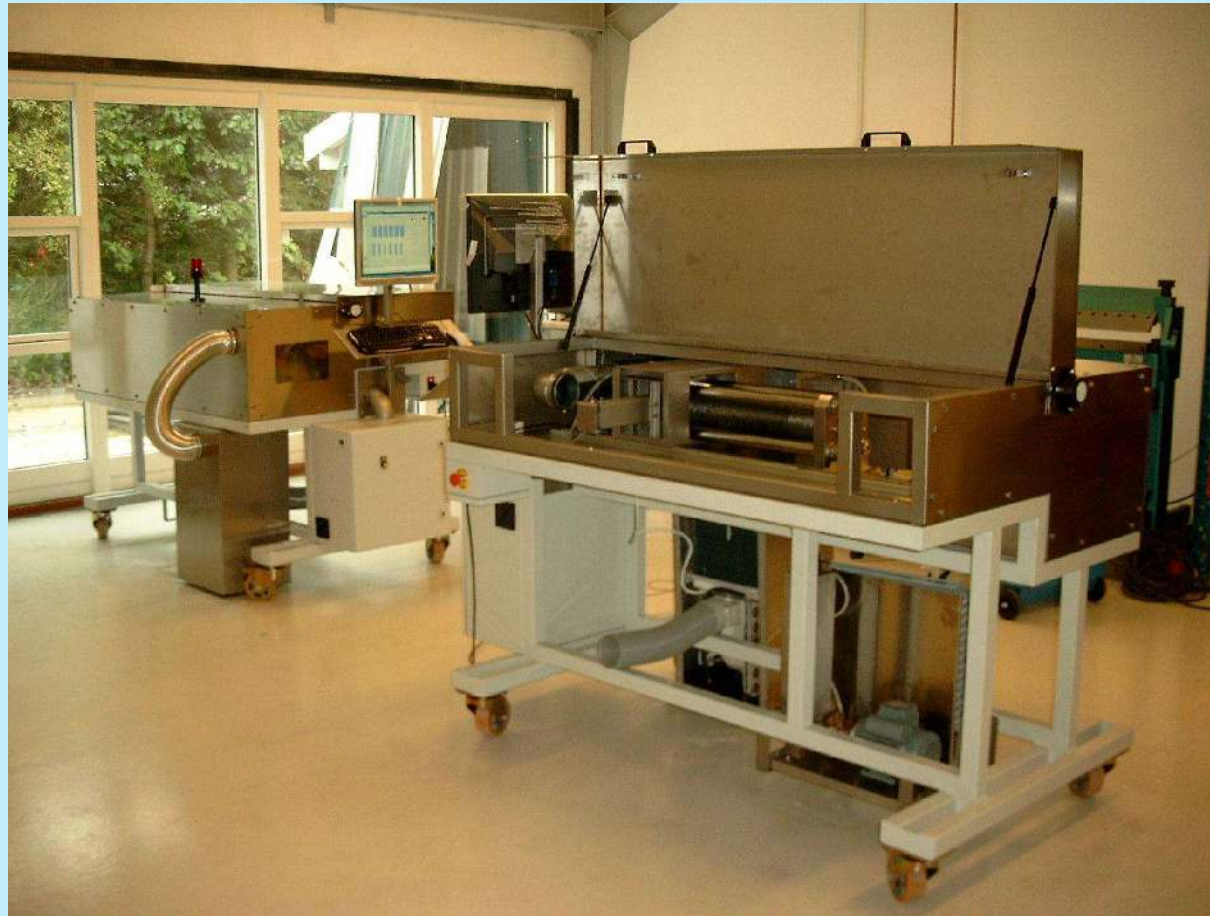


X-ray inspection technologies

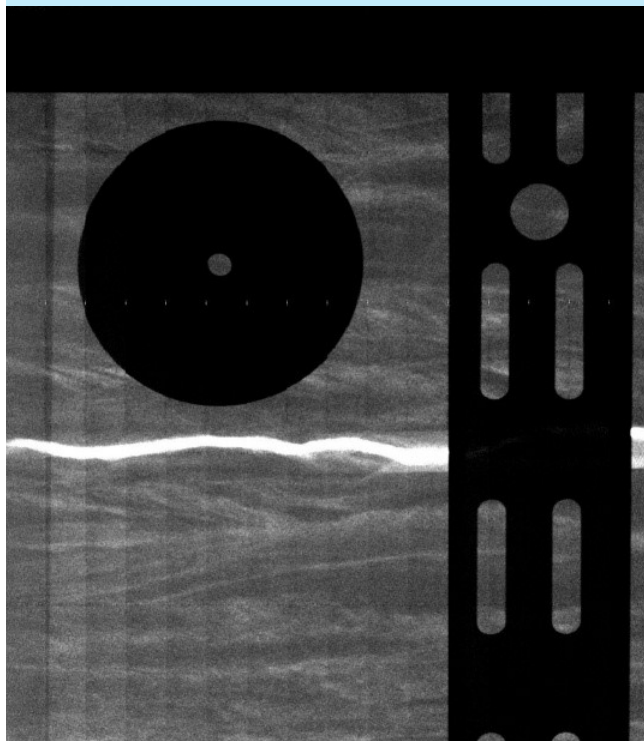
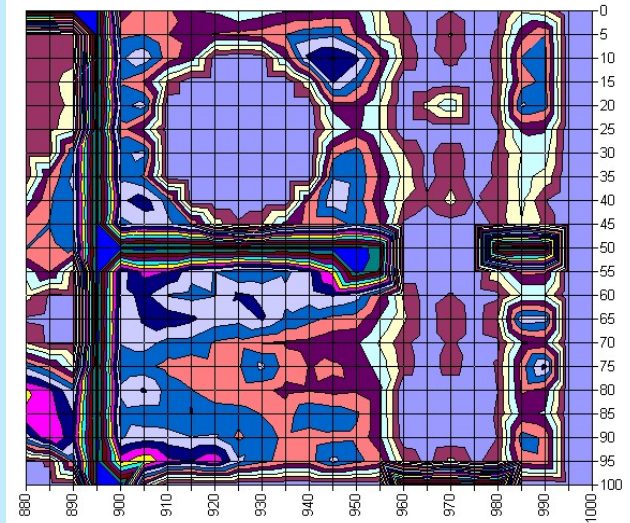
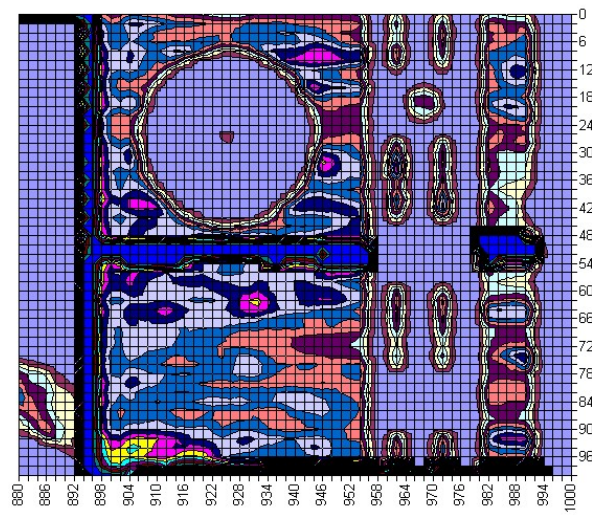
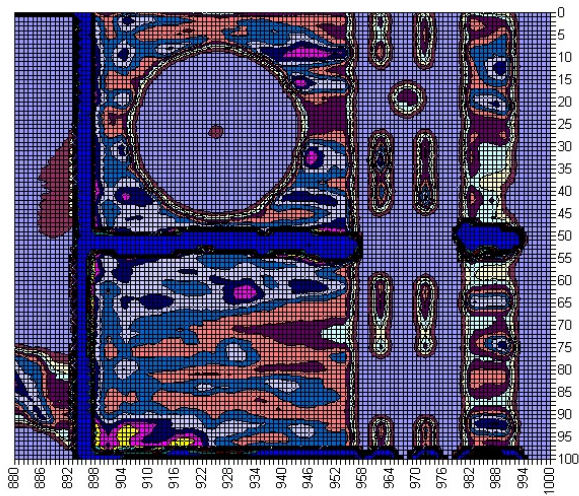
INNOSPEXION





Quantitative reservoir rock studies using X-rays

X-ray imaging for reservoir studies



THE 3D-X-RAY CORE SCANNER integrates novel CdTe imaging technology for high sensitivity imaging at high speed of reservoir rock details. The photo at right ► shows the test set-up a steel disc atop a layered porous limestone. At left ◀ is shown the X-ray image, and above ▲ the X-ray attenuation measurement compiled from scan intervals of 1, 2 and 5 mm.

Note the details provided by the image.

Data & Photos: © UNIFOB, Bergen, Norway.



? The scanner cabinet can be positioned vertically or horizontally, thus enabling the study of how the fluid flow may be influenced by the orientation of the strata. The system is operated from two independent software user interfaces each of which provide the complete and automatic control of the scanning parameters



PRECISION & SCAN SPEED

THE 3D-X-RAY CORE SCANNER has been developed for quantitative studies of the migration of various fluid in the rock sample. The positional accuracy depends on scanning speed, and the statistical accuracy depends on the rock, the thickness and the integration time. At routine usage, the X-Y position accuracy is about 0.5—1 mm, and the counting accuracy is about 1-2 per cent for an average count rate of 20000 cps.

Better precision is possible at the expense of scan speed. A total scan at 5 mm resolution of a 1 x 1 m² rock in counting mode will take about 250² to 400² seconds, whereas the complete image scan takes about 5–30 minutes.



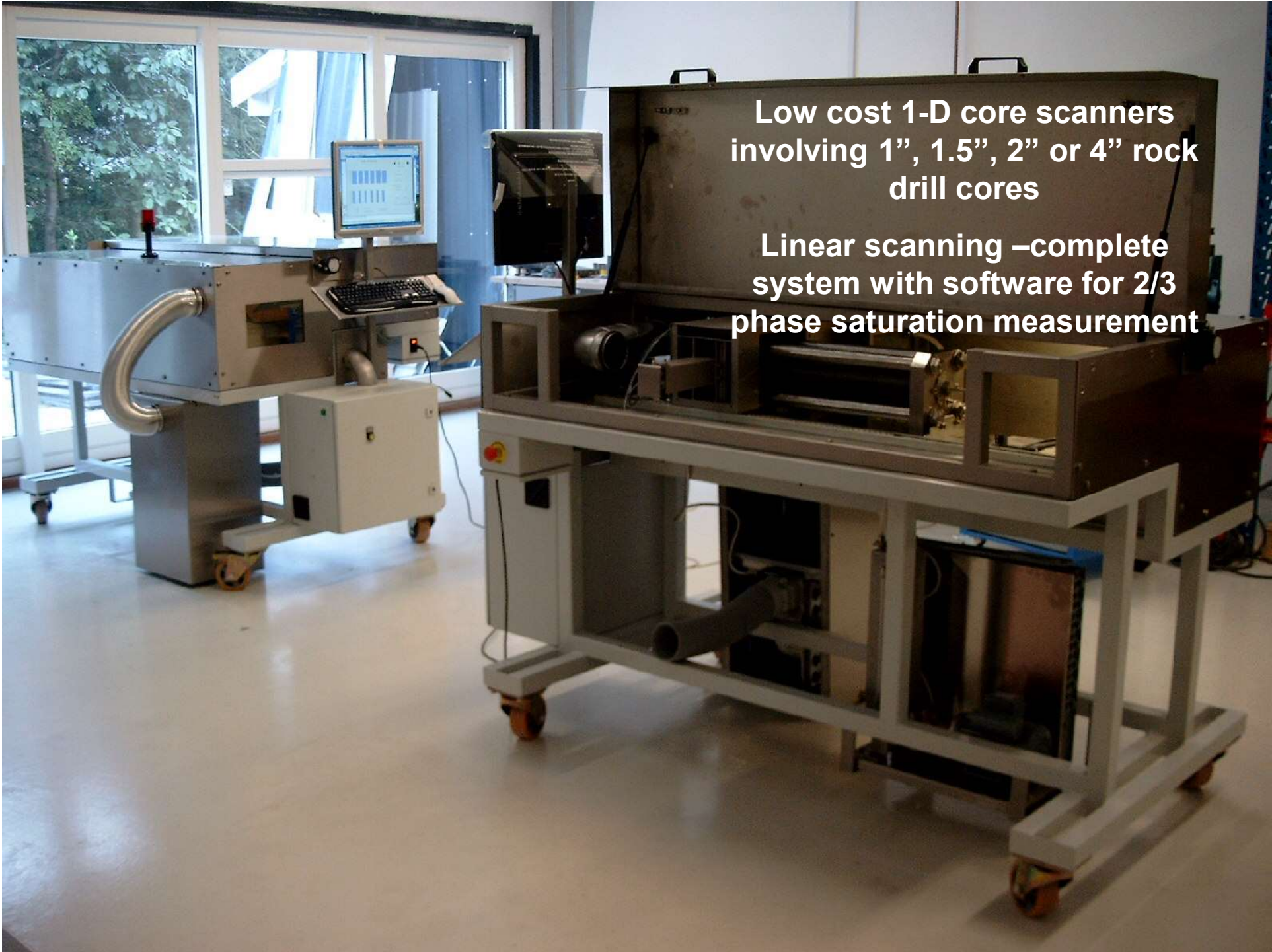
2-D core scanners involving 1", 1.5", 2" or 4" rock drill core holders are much faster, yet they only provide a one- or pseudo 2-D result. Imaging is not an option owing to the cylindrical nature. However, the systems are cost-effective and classical. Contact us for options on innovative, competitive solutions.

System at left courtesy of Norsk Hydro and Institut for Energiteknik, Norway © .

X-ray solutions also for:

- Micron-sized revelations
- Detection of foreign bodies
- Tailored inspection solutions

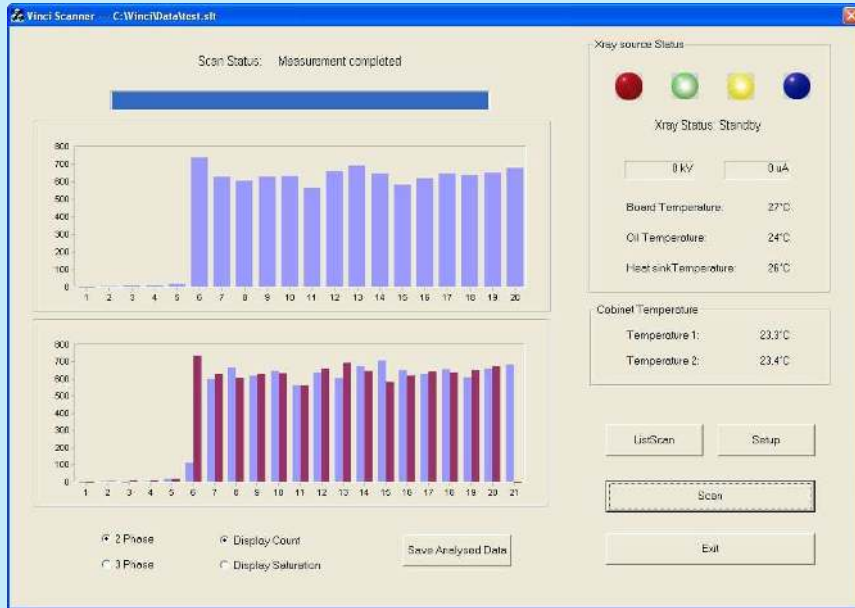
We "see", where others dont!



Low cost 1-D core scanners
involving 1", 1.5", 2" or 4" rock
drill cores

Linear scanning –complete
system with software for 2/3
phase saturation measurement

Complete software control w/ 2/3 phase calculations



Setting Parameters

Number of ID: 4

Scan Name: 100 % 100 % Di Dry core N/A Measure

Scan ID: 4000000 3000000 2000000 1000000 5000000

Scan Phase ID: 2 Phase 2000 3 Phase 3000

CalSample Position (End) 0

Start Position: 0 Cali Repeat: 5

Mark for DataStart: #Data 2-Phase only

Save log file every 2 minutes

OK Cancel Apply Help

Edit Scan

Start Position: 10 mm End position: 100 mm Step: 9.1 mm Integration time: 1 s Pause: -1 s

Load Scan Save Scan OK Cancel

Scan ID: Oil Scanned: Calibration Samples: 1 2 3 XRay setting: 20 kV 100 uA

Add Scan Remove Scan Clear all Edit Scan

Scan ID	Status	From ...	To mm	Step ...	Integration ti...	Pause s	Calibration	XRay Setting
Empty	Scanned	10	100	9.10	1	-1	Sample: 1	20 kV 100 uA
Core	Scanned	10	100	9.10	1	-1	Sample: 1	20 kV 100 uA
Water	Scanned	10	100	9.10	1	-1	Sample: 1	20 kV 100 uA
Oil	Scanned	10	100	9.10	1	-1	Sample: 1	20 kV 100 uA
Measure	Not Scanned	10	100	9.10	1	-1	Sample: 1	20 kV 100 uA
Measure	Not Scanned	10	100	9.10	1	-1	Sample: 1	20 kV 100 uA

Setting Parameters

X-Ray Setting: COM Port COM6

Wamup Setting: Factory Default User defined

Detector Setting: Default Count Time: 1000 ms Channel: 0 COM Port: COM4

Motor Setting: Reverse: Max Speed: 200 rpm Max Torque: 100 Gearing: 1068 COM Port: COM3

Temperature Sensor: Number Sensors: 1 COM Port: COM1

OK Cancel Apply Help

System for flow imaging in 100 mm diameter PVC pipes.

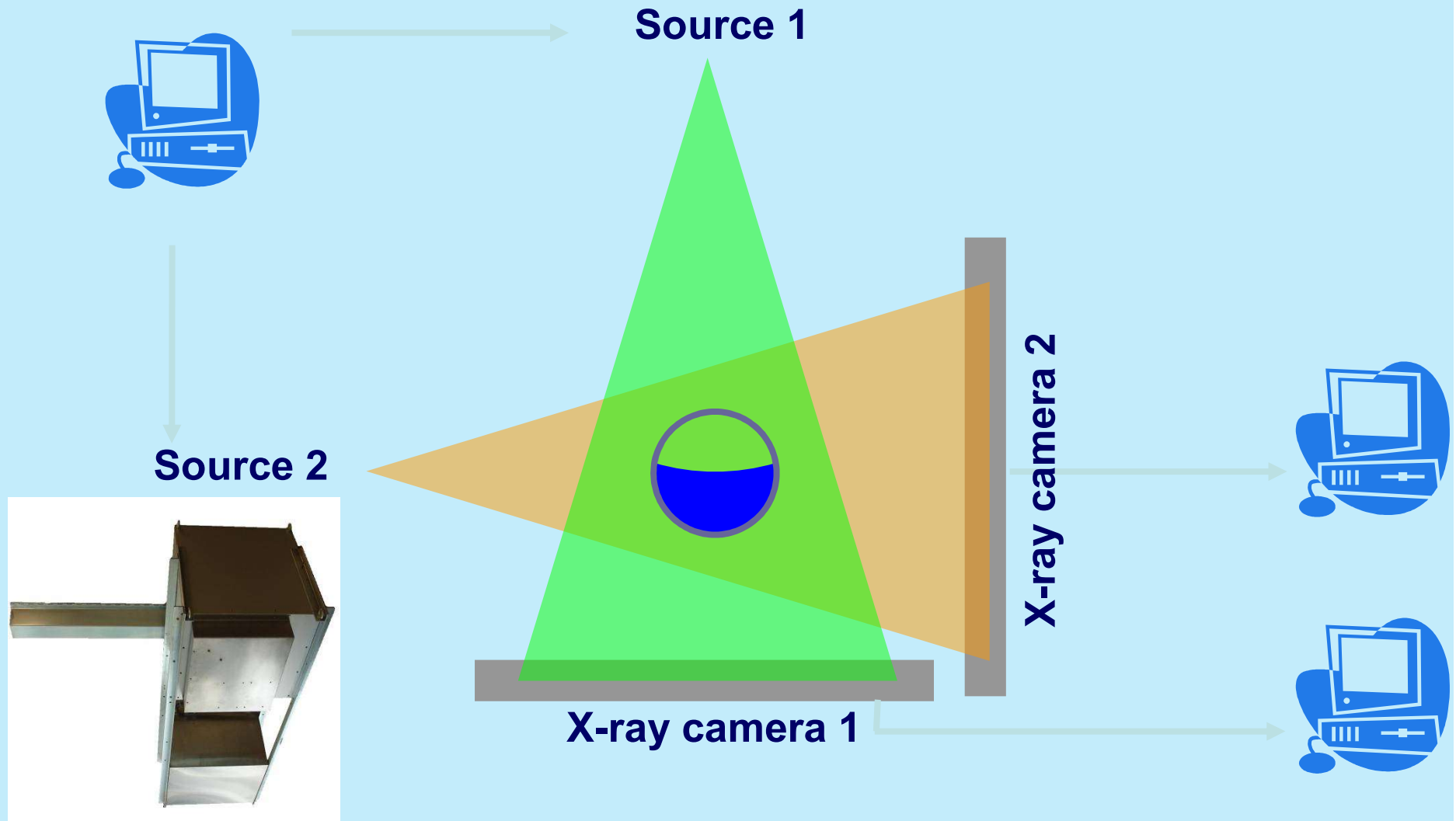
System at left courtesy of Institut for Energiteknik, Norway © .



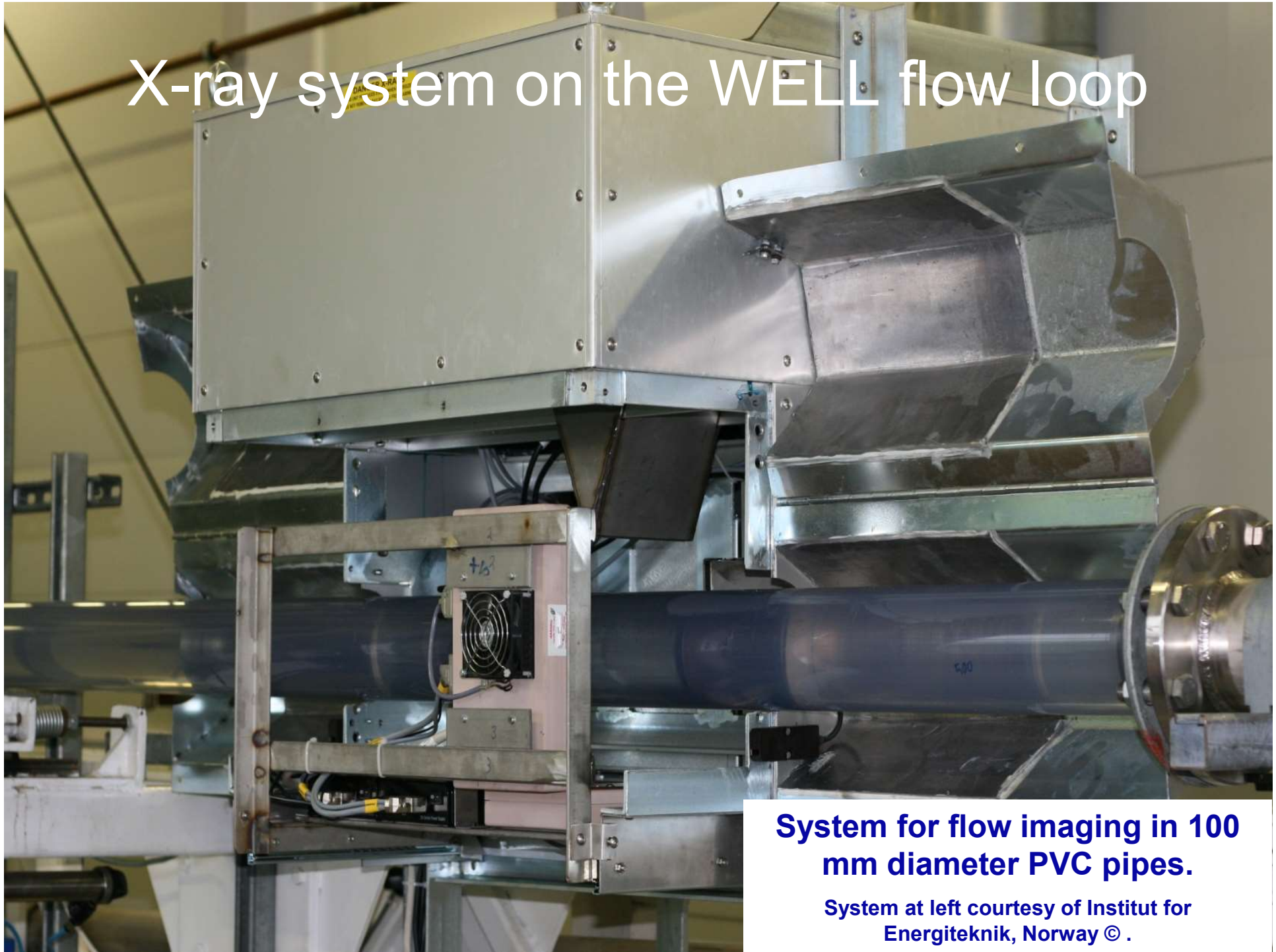
System for flow imaging in 100 mm diameter PVC pipes.

System at left courtesy of Institut for Energiteknik, Norway © .

Principle and



X-ray system on the WELL flow loop

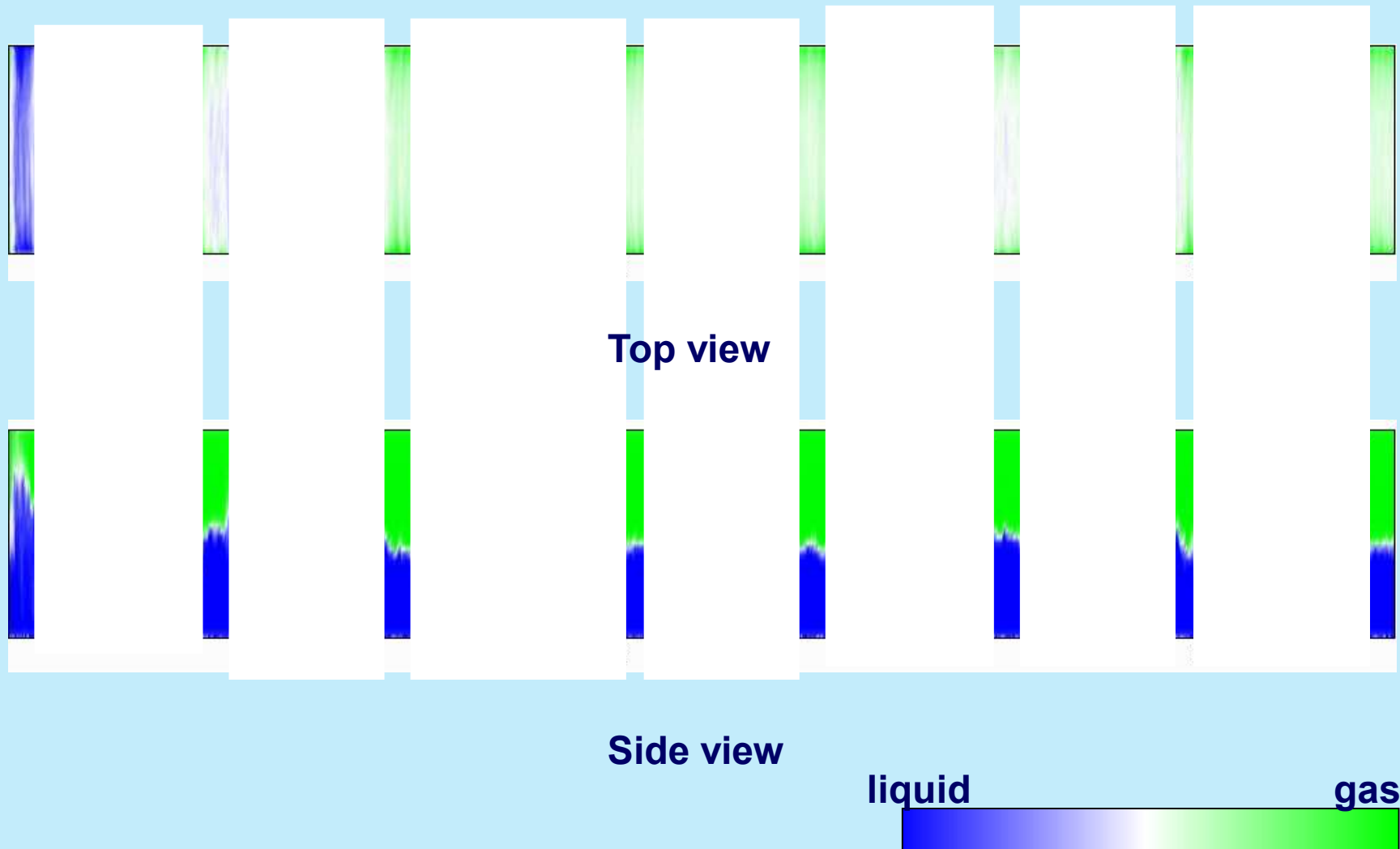


System for flow imaging in 100 mm diameter PVC pipes.

System at left courtesy of Institut for Energiteknik, Norway © .

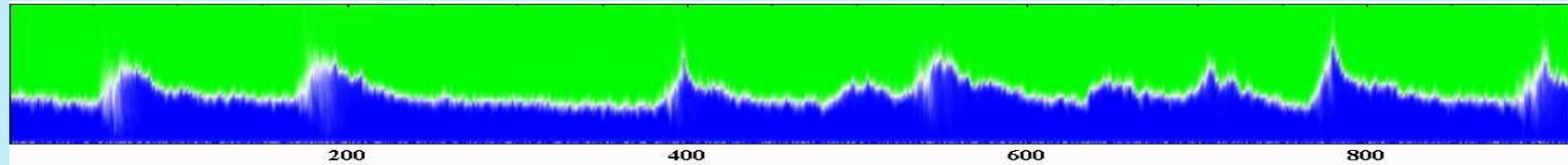


What can it measure?

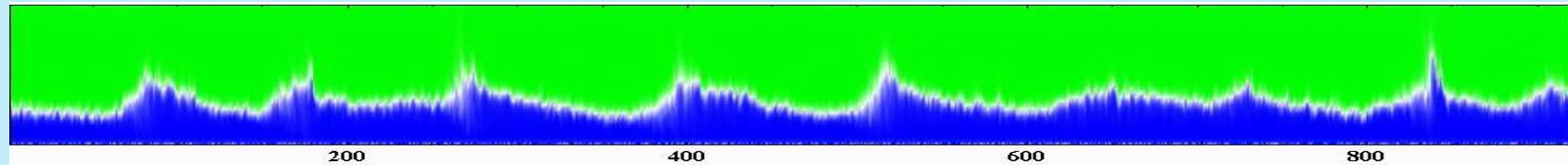


Comparison of time-history plots

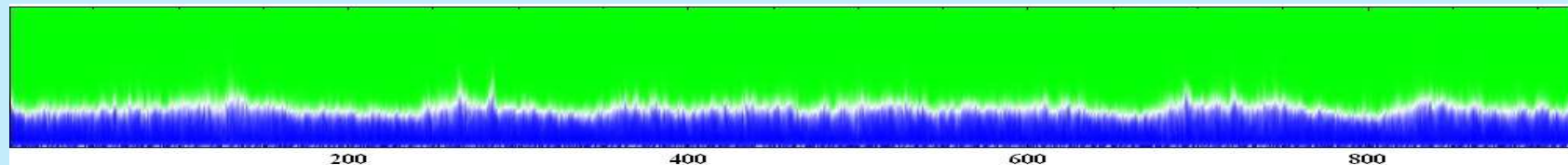
$U_{SL} = 0.5 \text{ m/s}$ and $U_{SG} = 2.5 \sim 7.9 \text{ m/s}$



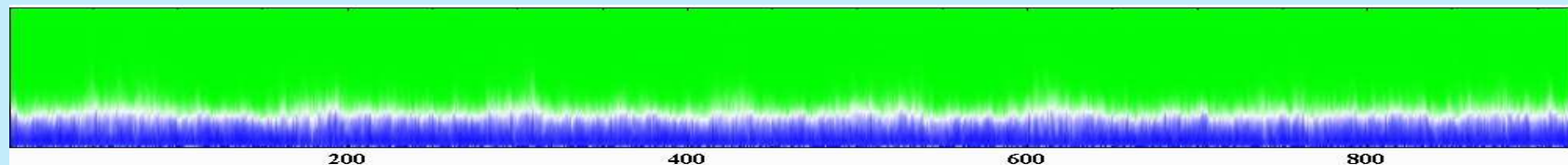
2.5



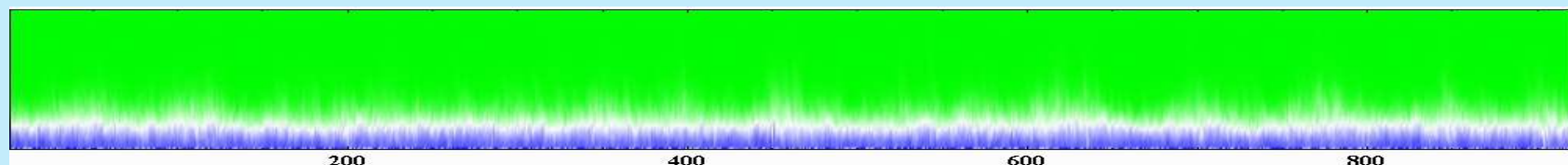
3.5



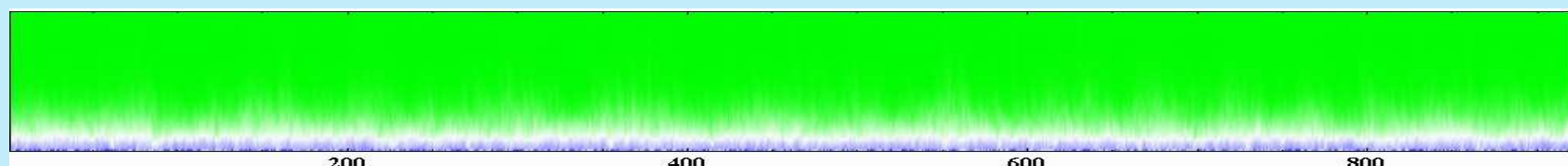
4.6



5.7

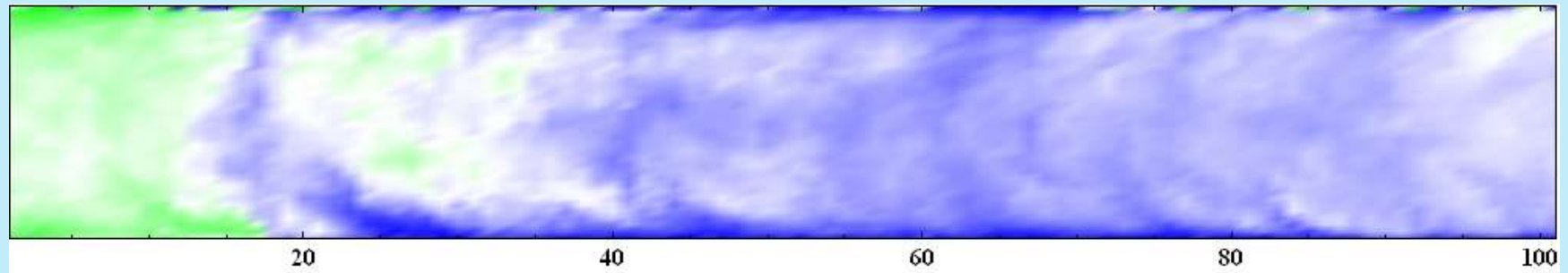


6.7

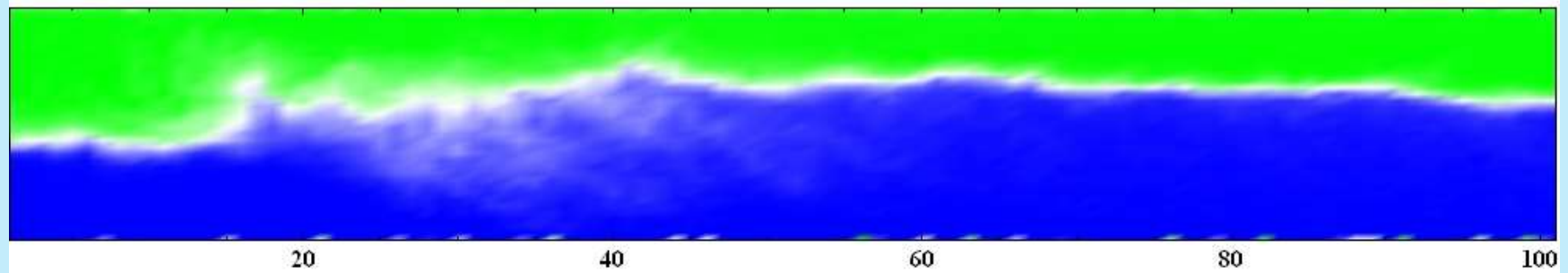


7.9
m/s

Mixing of phases at a wave front

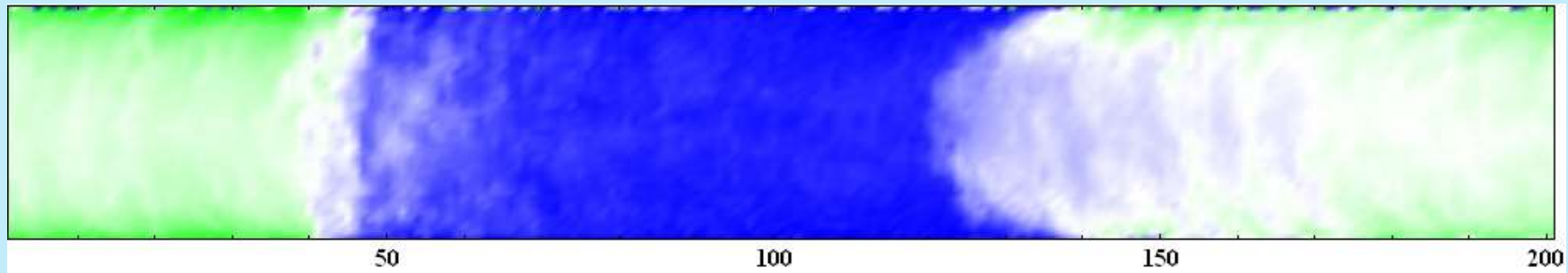


Top view

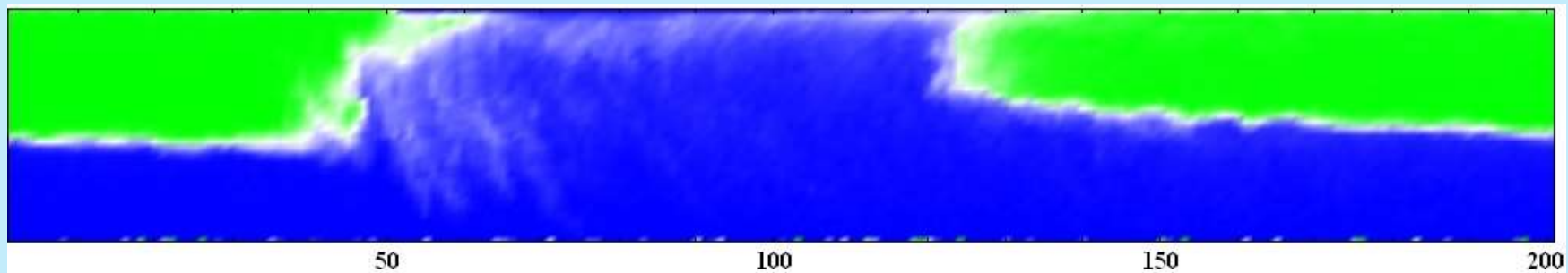


Side view

Mixing and distribution of phases in a slug



Top view



Side view