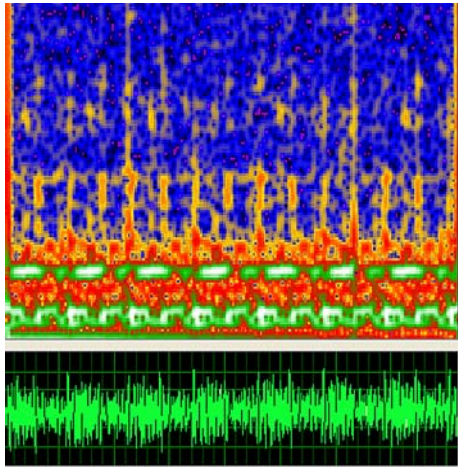
Highlights on computational support and foreseen intelligent data analysis

Rade Milenkovic, Sergejs Dementjevs, Jacek Patorski



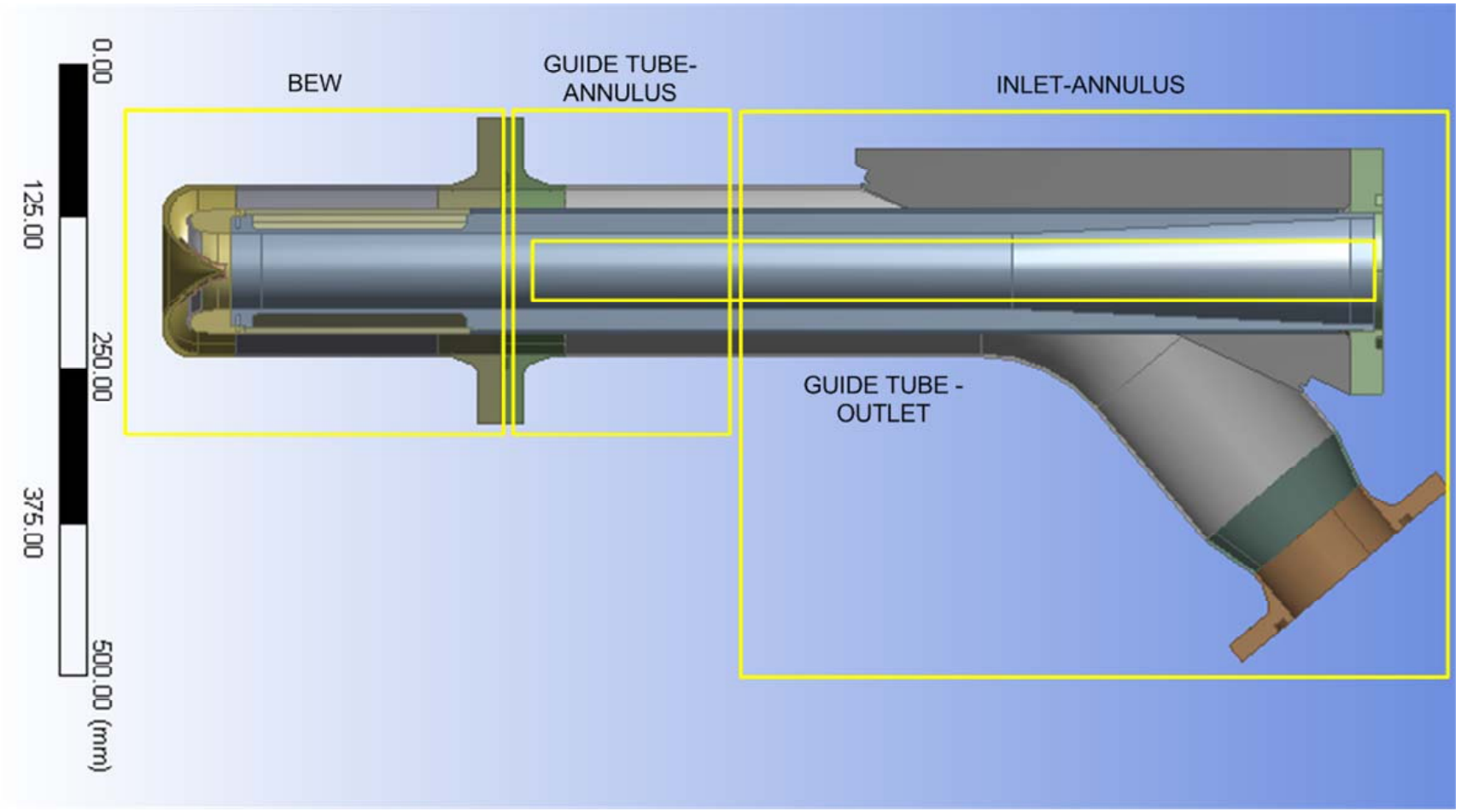
Overview

- Steps foreseen
- Highlights on computational support- sources of instabilities
- Data analysis and post-processing

Steps foreseen

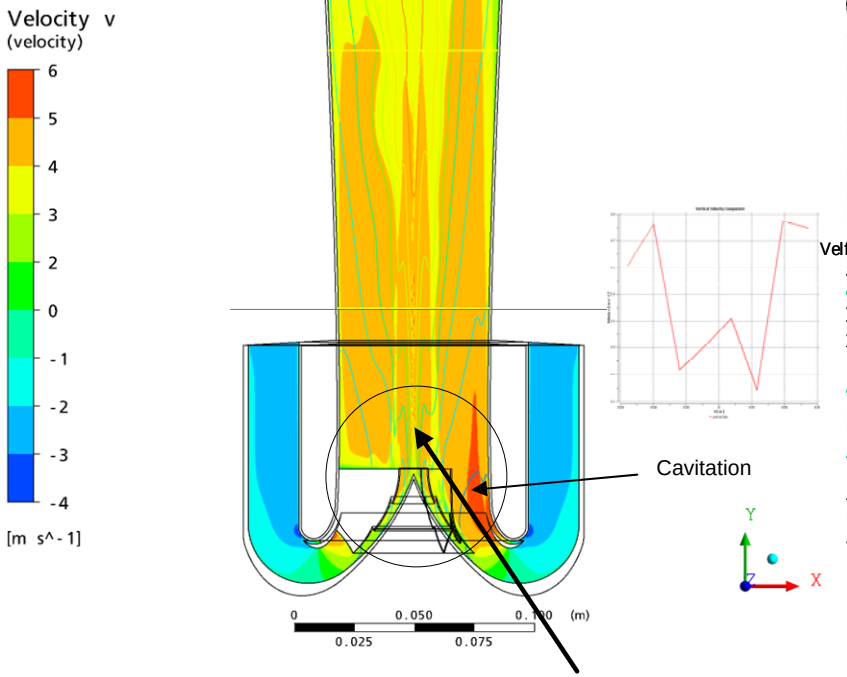
- Intelligent and detailed data post-processing and data analysis
- Make use of current 2D and 3D models to provide computational data for comparison with experimental data
- Post-processing, analysis and interpretation of existing CFD-RANS data
- Keep current design or re-design some parts?
- Concept of new 2D and 3D model of the complete target (parametric!)
- Plan for further thermal-hydraulic calculations will consider the following: optional geometrical changes and operating conditions, as well as computational capabilities and assigned time

Existing 2D and 3D models

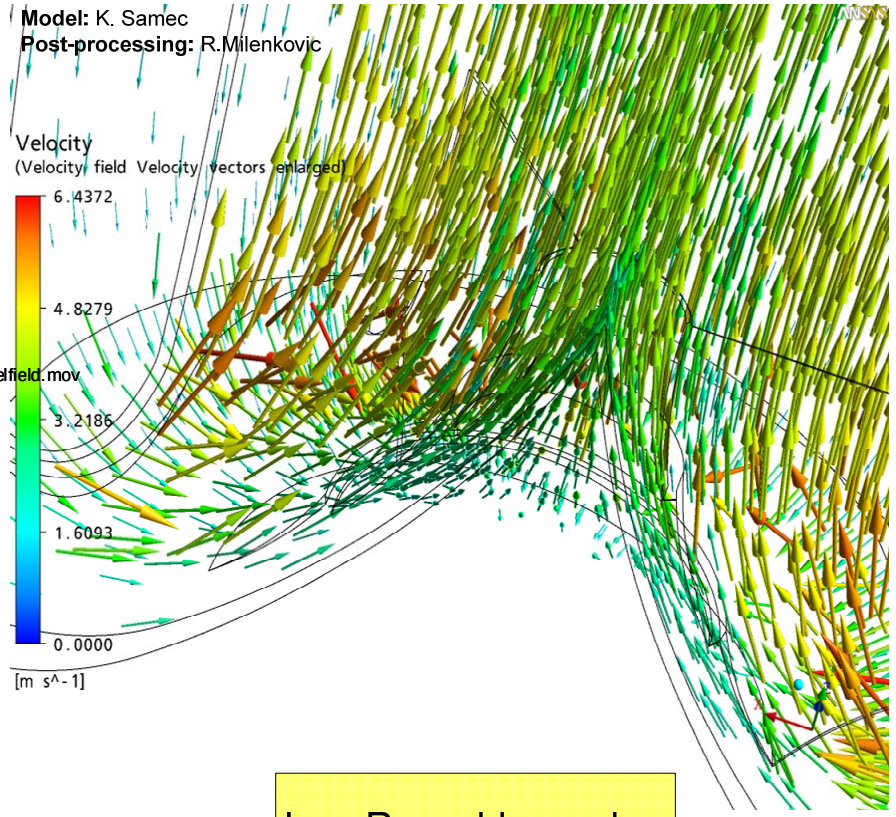


Velocity Fields

Model: K. Samec
Post-processing: R.Milenkovic



Velocity field near walls

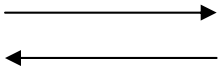


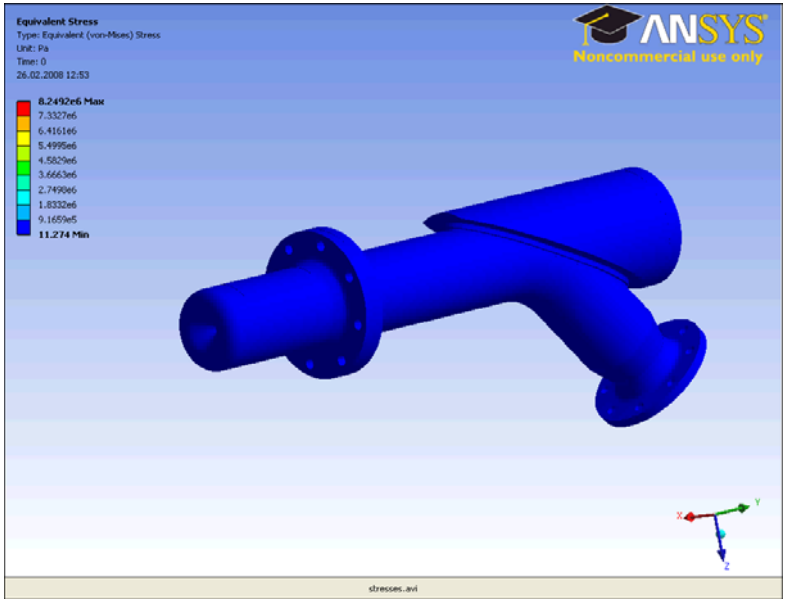
Low Reynolds number cubic or quadratic turbulence models, y+<1, 15 nodes in the boundary layer

Coupled fluid-structure interactions

Example of flow instability

C:\Documents and
ettings\milenkovic\M





Flow induced force

Can be estimated as follows:

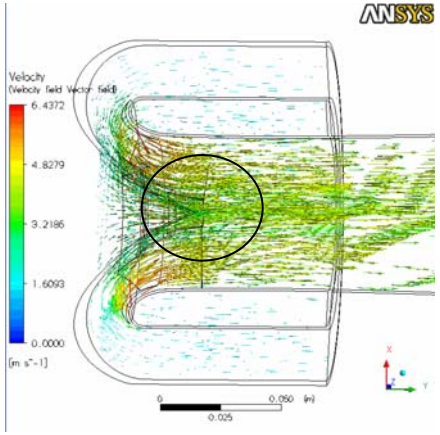
-acceleration of the structure is measured by acceleration sensors,

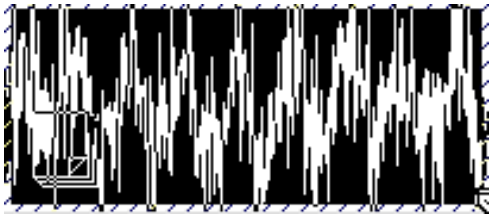
-velocity and displacement are determined by integration of the acceleration signal,

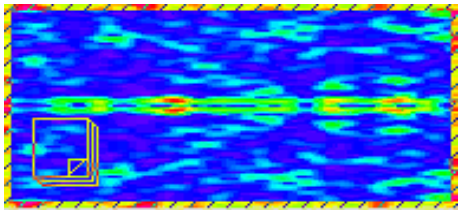
-The damping characteristic and the frequency of the fundamental mode can be estimated from free vibration test,

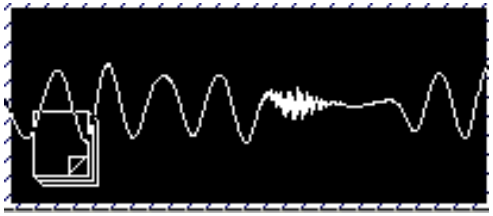
-The effects of Re, p, turbulence, etc. on Flow Induced Force can be investigated.

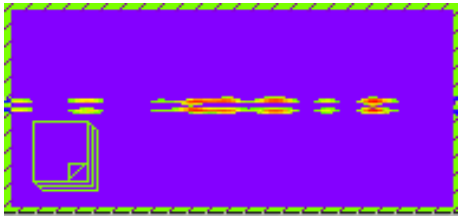
Signal decomposition



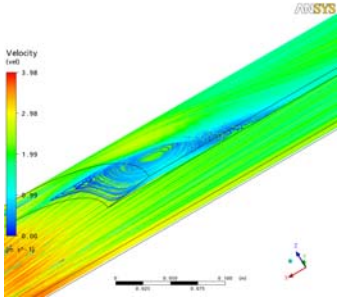


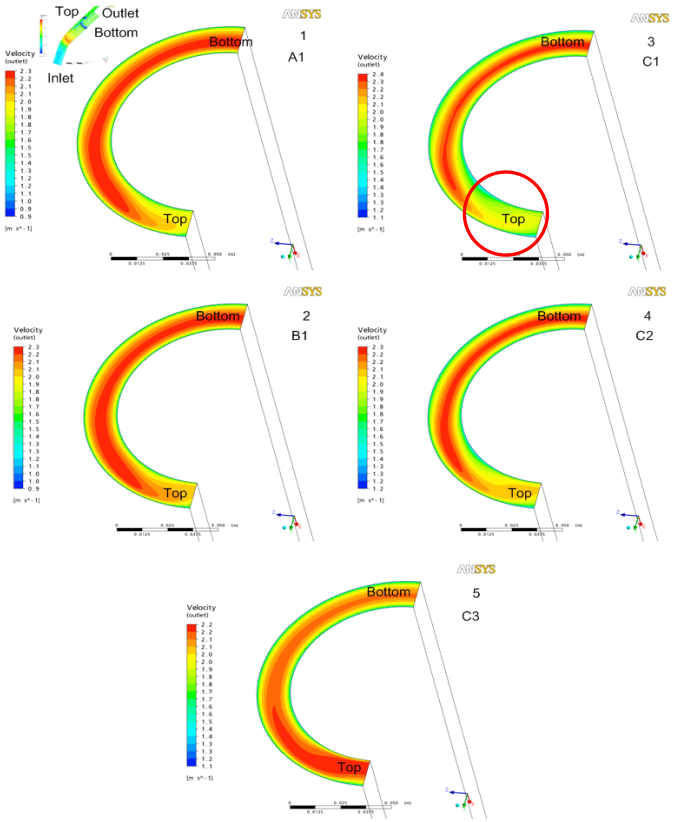


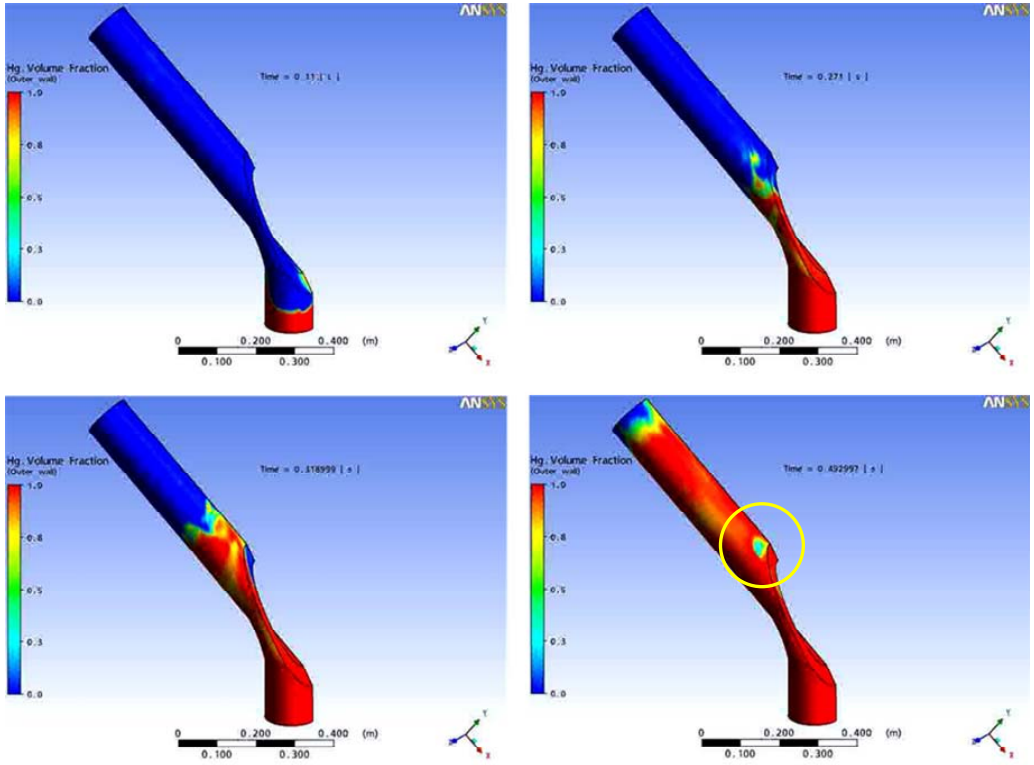




Sources of instabilities







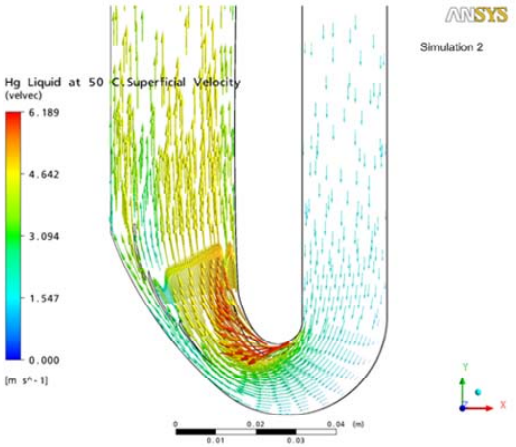
Cavitation

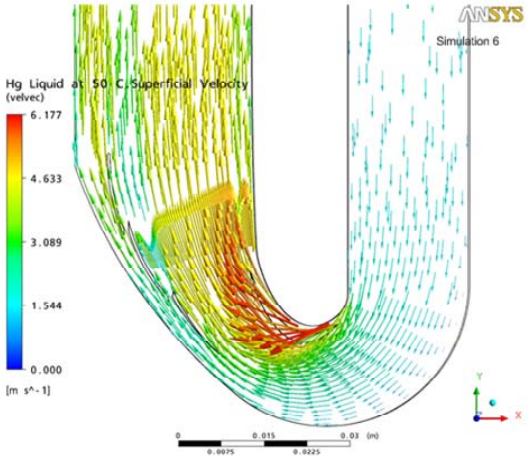
simno[Y]	min[Y]	win[Y]	Re[Y]	Ca[Y]	pin[Y]	pout[Y]	deltaP[Y]
	kg/s	m/s			bar	bar	bar
2	2.37	1.63	513625	9.11	1.63	1.00	0.63
6	2.37	1.63	513625	6.33	1.13	0.50	0.63

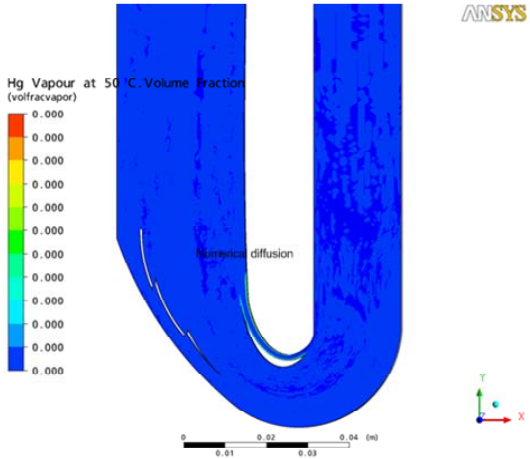
p<1.5 bar at the inlet
Mass Flow: 13 l/s

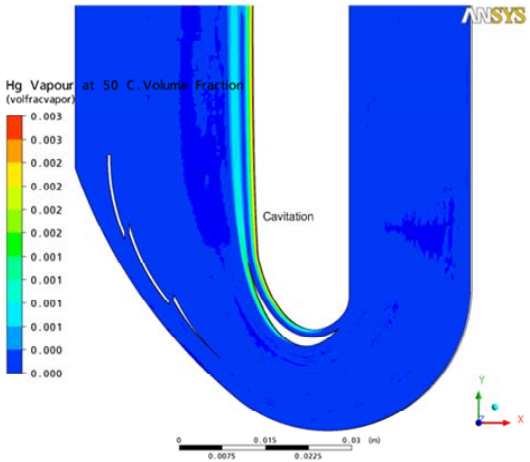
p (bar) is the relative pressure

Reference pressure is 1 bar.



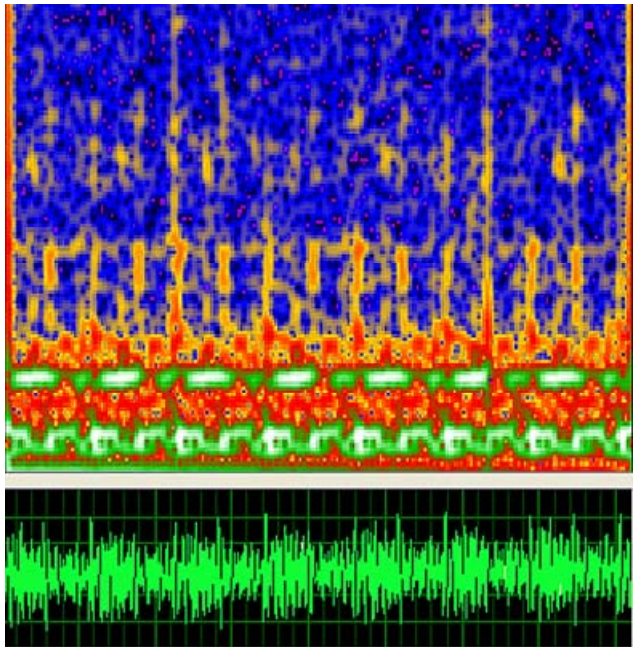


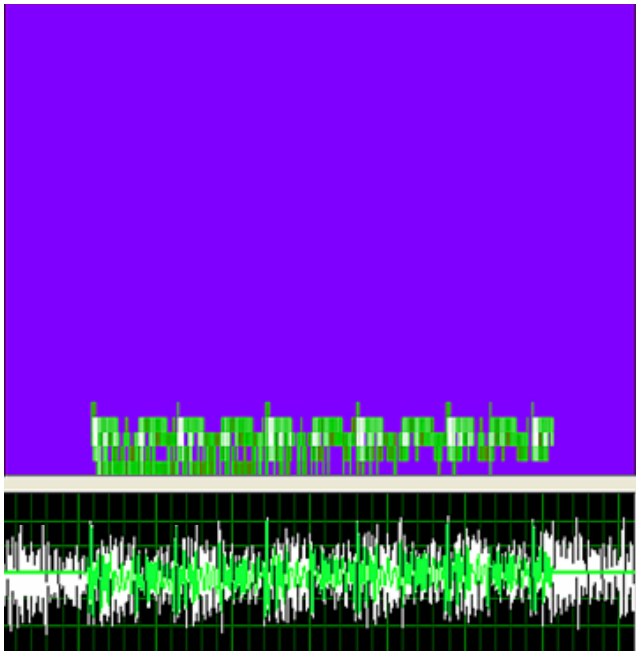




Intelligent Data Analysis

The main goal of advance and extensive data analysis is to estimate the intensity of fluid-structure interactions, to correlate amplitudes with inlet flow condition (Re,p) and to search for various causes of instabilities that may affect safe operation of the target.





Input: acceleration signal, pressure signal

Fast data acquisition

Frequency resolution

Parlez-vous Wavelets?

Methods and techniques, which are to be used, are described in TM_EURISOL_RM34_005, PSI, 2008

Conclusions

- Perform data post-processing and analysis
- Make use of existing 2D and 3D models to provide computational data for comparison with experimental data
- Results to be considered before planning any further steps