The VAVID Project

UNICORE Summit 2015

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September 7th, 2015

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The project VAVID

German acronym for “**V**ergleichende **A**nalyse **v**on **i**ngenieurrelevanten Mess- und Simulations**d**aten” or *Comparative Analysis of Engineeringly Relevant Measurement and Simulation Data*.

Pursued goals:

Develop improved methods for the **compression**, **analysis**, **management**, and interactive **visualization** of simulation and measurement data

in order to

Make the **comparative analysis** of large amounts of such data feasible.

The project VAVID

- Duration of 3 years (September/October, 2014 to August, 2017)
- Total cost 3M€, 2M€ grant 01 IS 14005
- Funded by the German Federal Ministry of Education and Research (BMBF)

VAVID

Federal Ministry
of Education
and Research

The partners

Consortium:

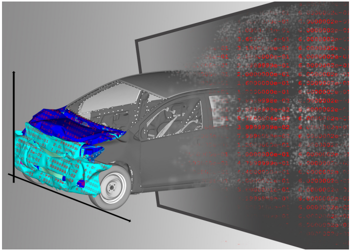
- Fraunhofer Institute for Algorithms and Scientific Computing (SCAI)
- Bosch Rexroth Monitoring Systems GmbH
- General Electric Global Research
- GNS mbH
- SCALE
- SIDACT
- Database Technology Group of the TU Dresden
- ZIH

Associated partners:

- Audi AG
- ParStream GmbH
- Volkswagen AG

The use cases

Car crash simulations



- investigate crash behavior
- improve safety

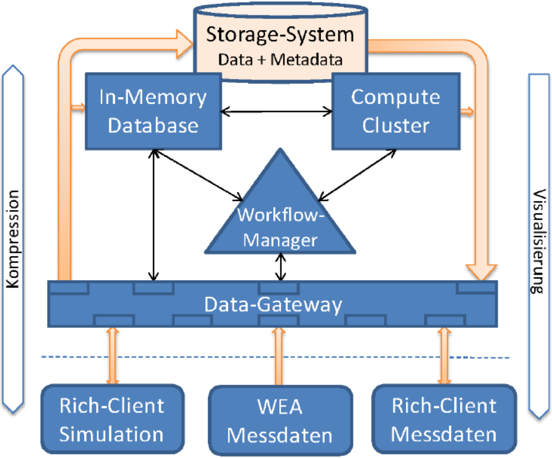
- 2-3 GiB data per simulation
- results archived
- several petabytes per year

Sensor data from wind turbines

- optimize components
- better maintenance strategies

- 600 wind turbines
- 100 MiB/turbine-hour
- data archived for 20 years

Conceptual idea



Wind turbine simulations

Simulation of wind turbines important when e. g.

- designing
- certifying
- locating optimal placement
- fine-tuning
- planing installation upgrades

Traditionally, simulations are done using finite element modeling (FEM) with a real prototype. Such models are usually kept secret by the manufacturers.

Condition monitoring of wind turbines

Condition monitoring systems (CMS) derive models from empirical data. VAVID uses sensoric and operational information from the turbines to derive a model for rotor blade oscillations.

⇒ Precise control strategies can be derived in order to reduce the wear of the installation.

Models have to be valid for different turbine types, operational modes as well as metereological conditions.

⇒ Large amounts of data have to be collected and analyzed

Wind turbine data analysis for condition monitoring

General steps:

- Collecting and transmitting data
- Receiving and preprocessing data
- Signal decomposition to remove noise
- Features computation from time-dependent data
- Dimensionality reduction
- Classification and regression analysis

For each step (except the first two) several alternative algorithms have to be developed and evaluated.

⇒ well-defined workflows.

Workflow management in VAVID

People don't want to deal with batch systems and manual orchestration

⇒ Two possibilities for the users based on the experiences with the previous project MoSGrid:

- UNICORE through UNICORE rich client
- UNICORE through science gateway (gUSE-bundle)

UNICORE

gUSE grid and cloud
User Support Environment

UNICORE through a science gateway

User acceptance increases (in most cases) by:

- removing the need for the UNICORE client
- workflow management inside the well-known web-browser
- easier learn-curve due to reduced parameters and options
- templates with preconfigured or partially preconfigured workflows

gUSE

- Web-based interface WS-PGRADE
- Several computing backends through DCI bridge
- Several data sources through Data avenue
- Open source

gUSE + WS-PGRADE + Liferay offer the required functionality, worked well with UNICORE in MoSGrid, and are actively maintained by SZTAKI.

⇒ we keep them in VAVID.

The good, the bad, and the ugly

- Integration and single sign-on between components... (good)
- ...thanks to digital certificates (good for security, but cumbersome for the users)
- Java Web Start applications and applets required for editing workflows and generating assertions in gUSE (prone to problems, limited usability).

New workflow editor

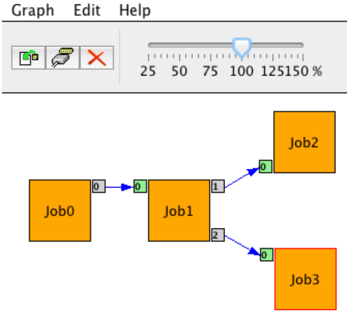
Replaces Java Web Start editor in gUSE

- part as subcontracted work (Gary McGilvary / Sandra Gesing / Malcolm Atkinson)
- part as a collaborative effort (OACT / SZTAKI / ZIH)
- available in gUSE's repository at Fusion Forge (own branch)
- officially adopted in recents versions

gUSE/WS-PGRADE Graph & Workflow Creation

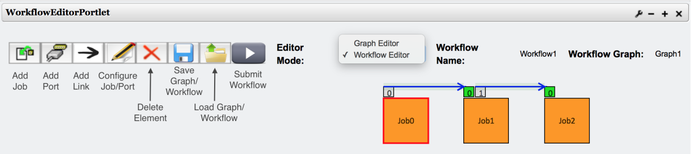
Traditional workflow creation in three stages:

- creation of abstract workflow (graph)
- creation of concrete workflow
- parametrization of the concrete workflow



Web-based workflow editor

- Builds on GraphEditorPortlet created by the OACT for mobile devices.
- Developed using KineticsJS, jQuery and jQuery UI
- Replicates the JWS editor both in functionality and presentation
- Split in 2 components: graphical editor front-end and back-end Liferay portlet implementation.


WorkflowEditorPortlet

Editor Mode: Graph Editor / ✓ Workflow Editor

Workflow Name: Workflow1

Workflow Graph: Graph1

Transition from Graph to Workflow Editor

Two use modes:

- graph mode: improved version of the OACT editor.
- workflow mode: allows direct interaction with workflows as well as to submit workflows to a configured DCI.

- New portlet WorkflowEditorPortlet inheriting from GraphEditorPortlet and Concrete plus additional functionality to allow users to directly interact with workflows rather than just graphs.
- Only code in common with the old editor is related to interface parts.
- Required improvements to both front-end, back-end, as well as necessary additions to gUSE.

Summary

VAVID aims to be a system capable of delivering easy to use HPC resources for big data anaylisis usable in industrial contexts.

This is achieved by a combination of digital certificates as well as middleware layers such as UNICORE and the gUSE-bundle.

Considerable effort must be put to achieve a user-friendly integration of the components.

Results go back to the community in open source spirit.