

Exploring unsteady flows by parallel extraction of property-enhanced pathlines and interactive post-filtering

Michael Vetter, Sebastian Manten, and Stephan Olbrich
Chair for IT-Management, Heinrich-Heine-Universität Düsseldorf, Germany

MOTIVATION

- Huge data sets
 - 3D grid: $\sim 10^9$ data points
 - Non-stationary: $\sim 10^4$ time steps
 - Data volume: ~ 100 Terabyte
- Volume / Flow visualization
 - Online viewing and batch processing support
 - High degree of interaction even in video-on-demand scenarios

SOLUTION

- Visualization middleware DSVR
 - Framework for „Virtual Science Labs“
 - Distributed, parallel, portable, modular approach
- High-throughput dataflow
 - Generation of 3D scenes
 - 3D streaming, remote viewing
- Browser-embedded controls
- Direct and parallel extraction of 3D geometries during the simulations instead of classical graphical post-processing
- Reduction of data volume ($O(n^3) \rightarrow O(n)$) by storing extracted 3D geometries instead of raw data
- Preserving the degree of interaction by post filtering of homogeneously seeded pathlines via "queries over streams" (query function σ)

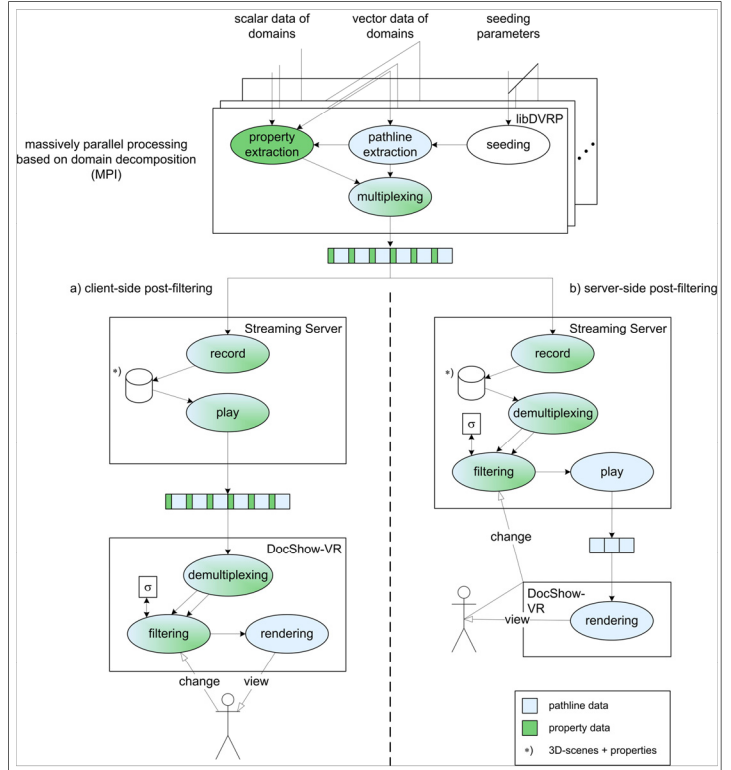
TECHNOLOGIES

- Parallel data extraction (MPI)
- Delivery over Gbit/s WAN (TCP/IP)
- Real-time streaming (RTSP)
- Replay of animations (OpenGL)
- Perceptual encoding, compression
- Support for C/C++/Fortran applications (software library *libDVRP*)
- For major operating systems

APPLICATIONS

- E-Science
 - Computational Fluid Dynamics
- E-Learning
 - Exploration / Presentation
 - Collaborative Scenarios

PROCESS CHAIN OF THE DSVR-FRAMEWORK



CHALLENGES

- Scalability on massively-parallel computers
 - Hybrid Parallelization Concepts (MPI/OpenMP)
 - Parallel Streaming
 - Efficient encoding and load balancing
- Performance over 10 Gbit/s network

CONTACT

Email: m.vetter@uni-duesseldorf.de
olbrich@uni-duesseldorf.de
Web: <http://www.itm.uni-duesseldorf.de/>

FIRST EVALUATION: FLOW VISUALIZATION OF A TORNADO-LIKE SIMULATED SWIRL

