A Parallelized Streaming Framework for Simulation and Visualization Grids

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Motivation
- Huge data sets
  - 3D grid: \(10^9\) data points
  - Non-stationary: \(10^4\) time steps
  - Data volume: \(100\) Terabyte
- Volume / Flow visualization
  - Online viewing
  - Computational steering

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

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
- For major operating systems

Challenges
- Scalability and load balancing on massively-parallel computers
- Flexible resolution and multi resolution visualization approaches
- Synchronous composition of different visualization techniques
- Efficient encoding for streaming and storage
- Performance over 10 Gbit/s network

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

Cooperations
- Center of Information und Media Technology, University of Düsseldorf (ZIM)
- Institute of Meteorology and Climatology, Leibniz University of Hannover (IMUK)
- German High-Performance Computer Center North (HLRN), Project nik00015
- German Research Foundation (DFG), Project EVITA (OL 241/1-1)
- Bull GmbH

Examples from the Large-Eddy Simulation group at IMUK:
- formation of dust devils (top), oceanic convection (middle), flow around city quarter of Shinjuku, Tokyo (bottom). See also: http://www.muk.uni-hannover.de/~raasch/PALM_group/PALM_group.html

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