Russian Academy of Sciences
Program Systems Institute

Applications and applied problems
Experience of real application of SKIF supercomputers

Within the framework of the SKIF program a number of applications, packages and libraries has been developed

- 6 applications in the OpenTS environment;
- 12 adapted free packages, libraries and applications;
- 14 in-house developed applications (3 of them in the field of AI).

Application Examples

- Chemical applications: quantum-chemical computations, forecasting and designing in chemistry (medicines and other compounds, Fig. 1).
- Chemical kettle designing.
- Aero hydrodynamic computations including aeromechanic computations for a case with high-drag bodies (Fig. 2).
- Gas dynamics, including numerical simulation of elementary processes of radiation gas dynamics.
- Processing of Earth remote sensing results.
- Formation of focused radar images (Fig. 3).
- Modeling of broadband space-time radar signals.
- Pixel processing of color and half-tone video-data.
- Hydro-meteorology: models of regional metcasts for 48 hours, calculus of approximations for weather forecasting, perspective meteorological models (Fig. 4).
- Systems of artificial intelligence (AI), analytical services, information service, science and national security:
    - classification of texts by classes defined in the process of training (in-depth text analysis, high relevance);
    - knowledge extraction from unstructured texts in the natural language;
    - tools for artificial intelligence system engineering.
- Medicine and telemedicine: cardio logical expert real-time system.
- Computing in the interests of nanotechnologies: numerical models realizing methods of molecular dynamics for simulation of nanostructures, bundled software for calculations of energy-band structures of solid bodies.
- National security. Special mathematical problems and algorithms for high dimensionality enumeration problems solution. Person identification system by voice, gathering, accounting and search for persons by their speech phonogram.
- Radio communications (civil and military). Optimization of frequency-territorial plans of radio electronic facilities taking into account electronic-magnetic compatibility.

National Cancer Institute USA
Reg. №
NCI-609067
(anti-AIDS agent)

TOSLAB (Russia-Belgium)
Reg. №
TOSLAB A2-0261
(anti-inflammatory agent)

National Cancer Institute USA
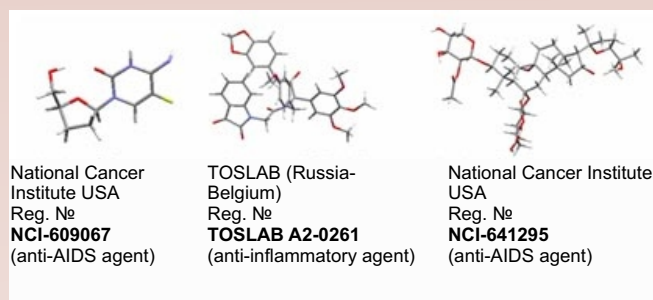Reg. №
NCI-641295
(anti-AIDS agent)

Fig. 1 CSU (Chelyabinsk State University): MultiGen: computations on SKIF cluster. Examples of substances.
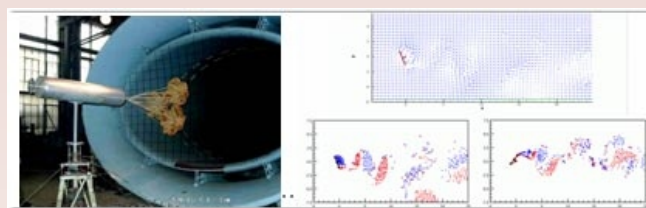

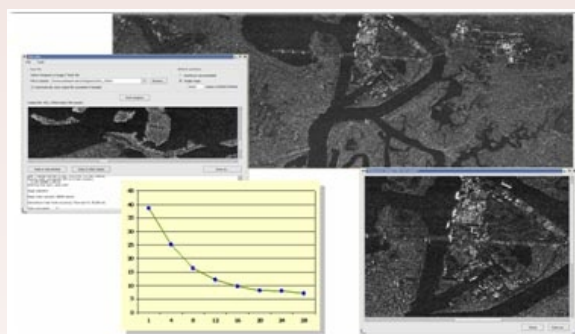Fig. 2. MSU Mechanics Research Institute: aeromechanics of high-drag bodies

Fig. 3. SSRI (Space Systems Research Institute): focused radar imaging using holograms of space-based Almaz radar.
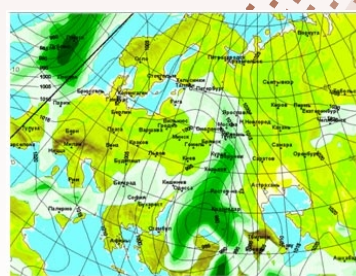

Fig. 4. PSI of RAS, Roshydromet: Prof. V.M. Losev model

Application Examples

- Calculations of phenomena with liberal share of radiant energy: calculation of characteristics of laser torch (Fig. 5), simulation of laser fritting processes (for medical produce), hypersonic movement of a space body in the dense air strata (Fig. 6); hit of an asteroid on the ground surface and others.
- Geomechanical problems: simulation of deformation processes on the earth surface (Fig. 7); simulation of underground structures' stability; deflected mode of undermined strata.
- Ecological modeling and forecasting including those in emergency situations: on-the-fly forecast complex for pollution wind transfer during emergency situations (Fig. 8).
- Banking information systems.
- Engineering computations:
  - automotive industry: design calculations for BelAZ mine trucks (Fig 11.); computations for transport vehicle crash (Fig. 12); turbocompressor calculations for forced induction of diesel engines; cardan shaft designing;
  - agricultural machinery: design calculations for next-generation Belarus tractors (Fig. 9); design calculations for tillage aggregates (Fig. 10);
  - aerospace engineering: detonation combustion, propagation of combustion chamber burner flame of gas turbine plant, strength assessment of aviation gas turbine engines;
  - light industry: modeling of dynamic behavior of ready-made garments and footwear (Fig. 13).
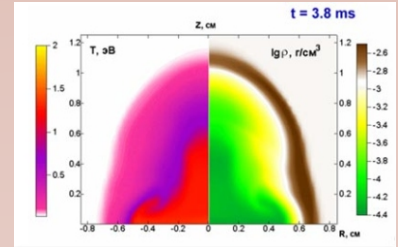

Fig. 5. A.V. Lykov ITMO of NAS of Belarus: dynamics of laser torch at the surface of solid target in the air
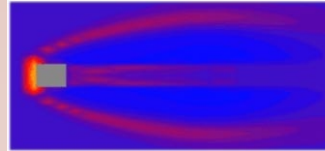

Fig. 6. A.V. Lykov ITMO of NAS of Belarus: hypersonic movement of a space body in the dense air strata
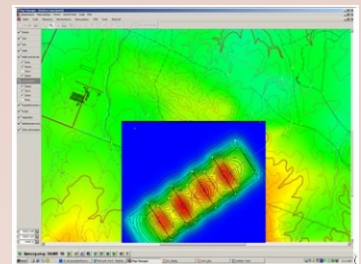

Fig. 7. BSU: modeling of deformation processes on the earth surface
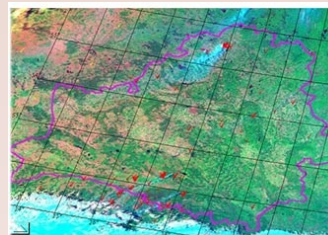

Fig. 8. OIPI NAN (United Institute of Informatics Problems of the National Academy of Sciences of Belarus) and NIP "Geoinformation systems": Forecast of pollution wind transfer during forest fires

Fig. 9. Modeling of next-generation universal Belarus tractor-frames
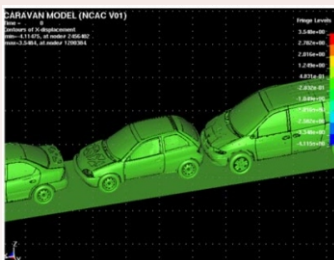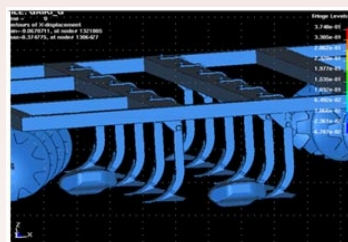

Fig. 12. Modeling of collision of three cars

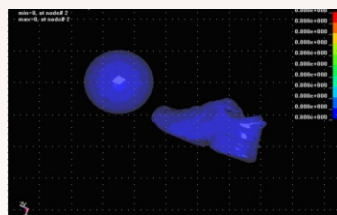Fig. 10. Modeling of tillage machines
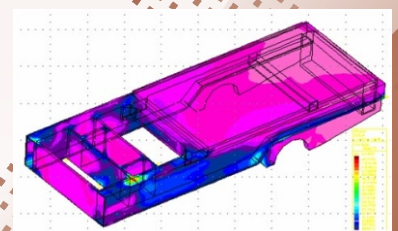

Fig. 13. Modeling of dynamic behavior of footwear

Fig. 11. Computing of supporting frames of BelAZ mine trucks.