iGrid 2002

THE INTERNATIONAL VIRTUAL LABORATORY

www.igrid2002.org

Amsterdam Science & Technology Centre (WTCW)
Amsterdam, The Netherlands

23-26 September 2002

Focusing on e-Science, LambdaGrid and Virtual Laboratory Applications

iGrid 2002, the 3rd biennial International Grid applications-driven testbed event, challenges scientists and technologists to utilize multi-gigabit experimental optical networks, with special emphasis on e-Science, LambdaGrid and Virtual Laboratory applications. The result is an impressive, coordinated effort by 28 teams representing 16 countries, showcasing how extreme networks, combined with application advancements and middleware innovations, can advance scientific research.

As computational scientists strive to better understand very complex systems – whether biological, environmental, atmospheric, geological or physics, from the micro to the macro level, in both time and space – they will require petascale computing, exabyte storage and terabit networks. A petaflop is one-hundred-times faster than today's largest parallel computers, which process ten-trillion floating-point operations per second (10 teraflops). An exabyte is a billion gigabytes of storage, and terabit networks will eventually transmit data at one trillion bits per second – some 20 million times faster than a dialup 56K Internet connection.

Recent, major technological and cost breakthroughs in networking technology have made it possible to send scores of *lambdas* on a pair of customer-owned or leased optical fiber, making the terabit network of the future conceivable. (Here, *lambda* refers to a fully dedicated wavelength of light, each capable of bandwidth speeds from 1-10 gigabits/second.) Research is moving from locally-connected, processor-centric environments to distributed-computing environments that rely on optical connections, where the networks are faster than the resources they connect. Researchers are moving from *grid-intensive computing* to *LambdaGrid-intensive computing,* in which computational resources are connected by multiple lambdas.

As a conference, iGrid 2002 demonstrates application demands for increased bandwidth. As a testbed, iGrid 2002 enables the world's research community to work together briefly and intensely to advance the state of the art – by developing new network-control and traffic-engineering techniques; new middleware to bandwidth-match distributed resources; and, new collaboration and visualization tools for real-time interaction with high-definition imagery. Much of the iGrid 2002 infrastructure will persist and be available for long-term experimentation.

LambdaGrid-intensive computing will become the main enabling technology for facilitating multi-institutional and multi-disciplinary advanced collaborations, enabling researchers to share unique resources and to have uniform and ubiquitous access to these facilities. In turn, this will enable the development of *Virtual Laboratories,* or science portals, for distributed analysis in applied scientific research. Groups worldwide are collaborating on major research projects, creating experimental platforms upon which future e-Science and large-scale distributed-computing experiments can take place. iGrid 2002 is a window into this world.

Application Demonstrations

APBioGrid (AU, JA, SI)
ATLAS LightPath Transfer (CA, CE, NL)
Bandwidth Challenge from Low-Lands (CA, CE, FR, IT, JA, NL, UK, US)
Bandwidth Gluttony: Physics (CE, US)
Beat Box (US)
Collaborative Access Grid (US)
D0 Data Analysis (NL, US)
Distributed Analysis (GE, JA, TA, UK, US)
Dynamic Load Balancing SAMR (UK, US)
Fine Grained Authorization for GARA (CE, US)
GENIUS (CE, IT)
Global Telescience with IPv6 (JA, TA, US)
Griz (NL, US)
High Performance Data Webs (CA, NL, SW, UK, US)
HDTV Over IP (SP, US)
Image Feature Extraction (GE, TA)
Kites Flying In and Out of Space (CA, FR, JA, NL, SI, US)
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Network Intensive Computing (GE, US)
PAAPAB (SW, US)
Photonic TeraStream (NL, US)
TACC Quantum Chemistry Grid (JA)
TeraScope (US)
TeraVision (US)
The Universe (UK, US)
Video IBPster (FR, GE, IT, US)
Virtual Laboratory on National Scale (NL)
Visiting Ancient Olympia (GR, US)
vIbiGrid (FI, NL, UK, US)

Participating countries/locations: Australia (AU); Canada (CA); CERN/Switzerland (CE); France (FR); Finland (FI); Germany (GE); Greece (GR); Italy (IT); Japan (JA); Netherlands (NL); Singapore (SI); Spain (SP); Sweden (SW); Taiwan (TA); United Kingdom (UK); United States of America (US).

Of course, during the week of iGrid, NL is an active participant in all these demonstrations!

USA, CANADA, FRANCE, JAPAN, THE NETHERLANDS AND SINGAPORE

Kites Flying In and Out of Space

URL

http://calder.ncsa.uiuc.edu/ART/MATISSE

CONTACT

Tom Coffin, *National Center for Super computing Applications (NCSA), University of Illinois at Urbana-Champaign (UIUC), USA*
tcoffin@ncsa.uiuc.edu

COLLABORATORS

Jacqueline Matisse-Monnier, *independent artist, France, and visiting artist, Mountain Lake Workshop, Virginia Tech Foundation, USA*
Tom Coffin, *NCSA/UIUC, USA*
Ray Kass, *Mountain Lake Workshop, Virginia Tech Foundation, USA*
Ron Kriz, Rob Strouse, *Virginia Tech, USA*
Francis Thompson, *School of the Arts, Virginia Polytechnic Institute & State University, USA*
Shalini Venkataraman, Jason Leigh, *Electronic Visualization Laboratory, University of Illinois at Chicago, USA*
Paul Weilinga, *SARA Computing and Networking Services, The Netherlands*
Ulrike Kasper, *Sorbonne and La Cité Museum de Musique Paris, France*
Kukimoto Nobuyuki, *Virtual Reality Development and Research Laboratory, Tohwa University, Japan*
Kurichi Kumar, Jie Wei, *Institute of High Performance Computing, Singapore*
Brian Corrie, *New Media Innovation Center, Vancouver, British Columbia, Canada*

DESCRIPTION

This virtual-reality art piece is a replication and study of the physical properties of the flying kinetic artwork of Jacqueline Matisse-Monnier. The complexity involved with calculating and rendering data is facilitated by distributed computing over high-speed networks.

Because the calculations for these kinetic art pieces (kites) are so computationally intensive, a single PC can only support the simulation of one kite. To support the many kites flown at iGrid, collaborators with computing resources around the world are performing the physically-based kite simulations at their home institutions and then streaming the results of the calculations, in real time, to Amsterdam. In essence, this is grid computing for arts.

ACKNOWLEDGMENT ●

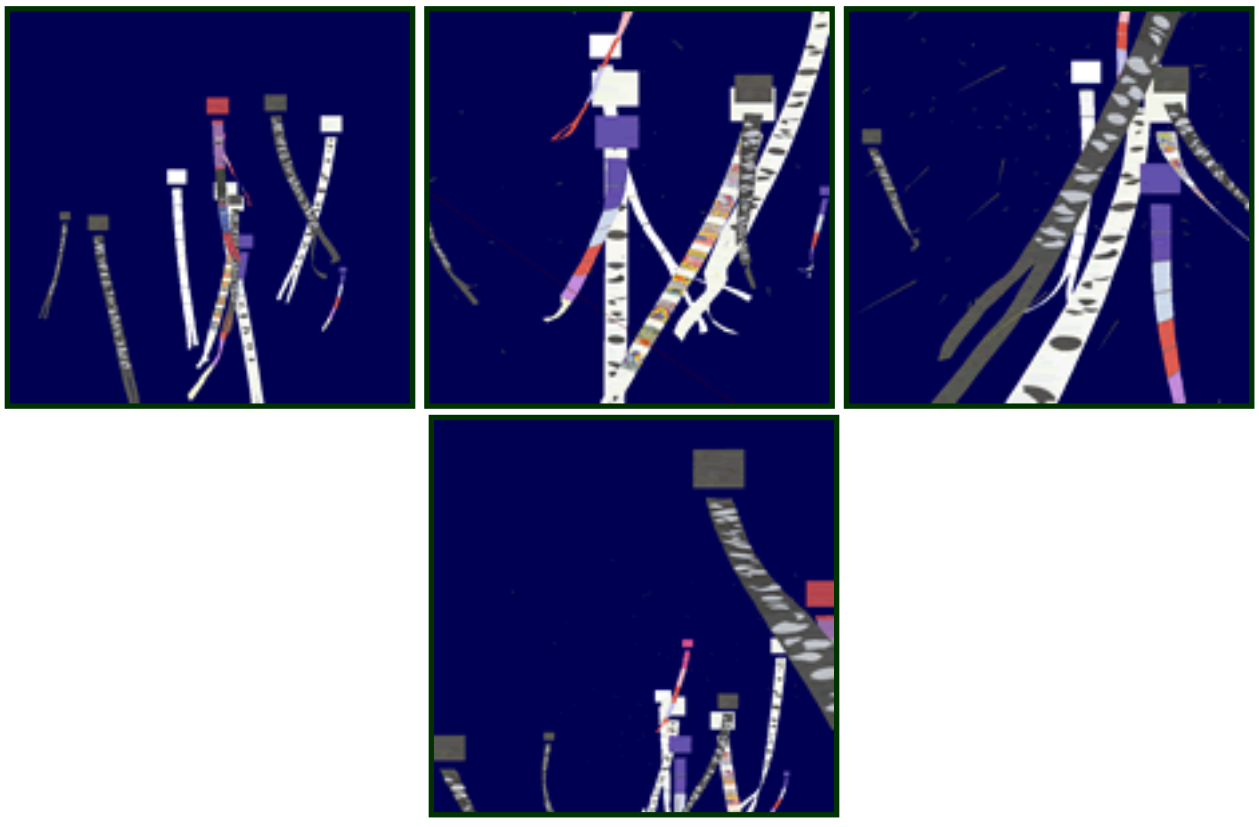
Quanta

Kites Flying In and Out of Space

[project description] [people] [mt. lake workshop movie] [igrid2002 movie]

Kites Flying In and Out of Space

By Jackie Matisse, in collaboration with: Tom Coffin, Ray Kass, Ulrike Kasper, Jason Leigh, Francis Thompson, Shalini Venkataraman, and Paul Weilinga. *With special thanks to the following Institutions: The Mountain Lake Workshop of the Virginia Tech Foundation, SARA (Amsterdam, Netherlands), Electronic Visualization Laboratory at the University of Illinois at Chicago, National Center for Supercomputing Applications at the University of Illinois Urbana-Champaign, Alliance Center for Collaboration Education Science and Software (Arlington, Virginia), Sorbonne and La Cite Museum de Musique (Paris, France), New Media Innovation Center (Vancouver British Columbia), Virtual Reality Development and Research Laboratory, Tohwa University (Fukuoka, Japan), Institute for High Performance Computing (Singapore) and Starlight (Chicago).*



Jackie Matisse's "Kites Flying In and Out of Space" is the first high bandwidth art piece ever created. Exhibited at the iGRID2002 Conference September 23-26th 2002, hosted by SARA in Amsterdam, Netherlands, September 23-26, 2002, "Kites Flying In and Out of Space" utilizes a "Grid" model for real time steering of calculations on computers distributed over high-speed networks. Each of the 12 kites appearing in the piece utilizes up to 15 megabits per second. This art piece uses a total of approximately 180 megabits per second in calculating the forms and theoretically could utilize even more. CAVEs around the world could potentially view this application through a connection to the Starlight high-speed networking program. The kite structures are so complex to simulate that a distributed computational model using processors on multiple machines is needed. "Kites Flying In and Out of Space" enlists servers distributed across the globe in Chicago, Canada, Japan, Singapore and Virginia to calculate its forms. Each of these servers "stream" a single kite to SARA in Amsterdam where they are then displayed in a CAVETM.

A participant in the CAVE presentation can manipulate the kites and control the wind. When a person injects wind into the scene, messages are sent to all the servers. These messages contain information regarding wind direction and strength. The servers then calculate the modifications to their individual kite structures. That information is then streamed back into the CAVE. This process is called real time simulator steering and it is the basis for the steering of high performance calculations on super computers distributed over a high-speed network. This "grid" model has never been used for art prior to "Kites Flying In and Out of Space". It is an example of "Grid" computing, resulting in an original work of art.

"Kites Flying In and Out of Space" is a collaborative art piece initiated by the Mountain lake Workshop of the Virginia Tech Foundation in 1999. Jackie Matisse was invited to participate in an experiment in virtual reality using her imagery.

Jackie Matisse speaks of the piece: "These kites are evolved from my use of the sky as a canvas and from my need to use movement in my work. The square head is a homage to Malevich the Russian suprematist painter of the black square. The kites have very long tails, which are derived from a Thai serpent kite which I lost over a forest and which flew with unbelievable ease. It had such lift and in my mind it became a flying carpet and with it I could travel in the air. I began making tails and this enabled me to put color and line into the sky. I have always been interested in the connection between art and science. Since my kites were very hard to fly in all conditions, I experimented with alternative spaces

such as underwater, video, and now virtual reality. The networking has enabled me to compose and fly many more kites than I would have been able to fly in real space."

The movement of the kites uses a physically based simulation technique called "mass spring" model. A mesh of approximately 250 points constructs each kite. The movement of the mesh translates to the movement of the kites.

"Kites Flying In and Out of Space" is scalable computationally as well as geographically. It is a very good test of high-speed networking because the application requires a multicast enabled network to accomplish communications. The kites have become a visual metaphor for network performance. The kites have different sections and the movement of these sections indicates the size and latency of the network data. A fast and smooth moving kite represents a good connection. A slow and jerky moving kite indicates a network connection with a problem. In this way, network performance can be visualized.

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this site maintained by:
Tom Coffin

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