

VEGA™

THE COMPREHENSIVE SOFTWARE ENVIRONMENT FOR REALTIME APPLICATION DEVELOPMENT

PRODUCT CATALOG



INNOVATION FROM .

MultiGen Paradigm

THE REALTIME 3D COMPANY

Complete Tools and Solutions for Visual and Sensor Simulation

MultiGen-Paradigm, Inc. offers complete solutions for visual and sensor simulation, generated from the industry-leading experience of its two founding companies. Since 1986, MultiGen Inc. has delivered groundbreaking visual modeling tools that make ease-of-use and productivity in visual simulation a reality. Paradigm Simulation, Inc. was founded in 1990, providing the most widely used commercial COTS tools for real-time visual and audio simulation development. The 1998 fusion of these established industry leaders gives MultiGen-Paradigm customers access to integrated technologies and services that enable the most productive and cost-effective development and deployment of advanced visual and sensor simulation applications today.

- Visual simulation, urban simulation, simulation-based training, game development, broadcasting
- Worldwide customer base includes leading flight, marine, driving, urban simulation and AEC companies, the US Air Force, Army, Navy, Marines, NASA, and video game developers
- Global partner with Silicon Graphics®, Inc.
- Close relationships with leading PC-based simulator vendors

Commercial Products That Match Your Needs

MultiGen-Paradigm develops powerful, highly automated, realtime 3D software tools and integrated image generator solutions. Our tradition of rising to the most demanding needs of our military and commercial customers is built on responding to you. We update our COTS tools according to customer input, a constant evolution that feeds you with upgrades or new product releases.

- Integrated, flexible, extensible, easily customized, fully supported tools and solutions
- Interactive creation, editing, viewing, and deployment of advanced applications
- Complete IG solutions provide the latest in image generation technology
- Compatible with Windows NT™ operating systems and Silicon Graphics® IRIX™ workstations

Professional Services

MultiGen-Paradigm maintains a team of visual simulation developers with a rich heritage of realtime 3D and simulation expertise, able to deliver industry-leading custom IG solutions. Our engineering team provides end-to-end custom solutions for visual and sensor simulation, including marine, ground vehicle, driving, urban and AEC applications, DIS/HLA, and audio simulation. MultiGen-Paradigm also formed and spearheads The Solution Group™, a consortium of realtime software and hardware providers that are experts in their fields.

- Complete IG solutions deliver the latest in image generation technology
- More choices, lower risk, faster decision-making
- Power to leverage industry expertise in any application area



Vega™ -- The Software Environment for Realtime Application Development

Vega is MultiGen-Paradigm's industry-leading software environment for the creation of realtime visual and audio simulation, virtual reality, and general visualization applications. It combines advanced simulation functionality with easy-to-use tools, creating an infrastructure for the simplest, most productive processes available to build, edit, and run high performance realtime applications. Vega includes the graphical environment LynX, a complete Application Programming Interface (API) that provides maximum software control and flexibility, a rich set of relevant libraries and AudioWorks2 realtime multi-channel sound. Optional modules further increase functionality in specialized areas. Vega and its optional modules run on both IRIX™ and Windows NT™ operating systems. Vega supports a wide variety of dataset loaders, allowing interactive visualization of many different data formats, and single or multi process application development.

- Reduce risk and improve asset utilization with COTS products
- Increase productivity with a consistent, compatible, and easy-to-use programming interface
- Attain predictable performance results and reduce development cycles
- Spend less time on graphics programming issues and more on domain-specific problem-solving
- Optimize realtime performance easily; see changes as you make them
- Meet demanding budgets and development schedules
- Improve maintainability and support of applications



Vega MP and Vega SP

Vega is available in multi-process (MP) and single-process (SP) configurations. Applications developed under Vega SP can be re-compiled with Vega MP for full multi-process functionality.

Vega MP

- Provides the ultimate development and runtime environment for multi-processing hardware configurations
- Logically distributes application, culling, and drawing tasks across available processors for optimal performance
- Allows the user to assign graphics and processing tasks to specific processors in the workstation
- Allows the user to customize the system configuration to meet the most demanding performance objectives

Vega SP

- Offers a low cost solution for systems with a single CPU
- Supports the development of applications using a single process runtime model



LynX™

Vega comes with an extensible point-and-click graphical user interface, LynX™. LynX increases productivity by enabling changes to significant application parameters without coding or re-compiling. Changes to application functionality, visual channels, multi-CPU allocation, eyepoints, observers, special effects, time of day, system configuration, models, databases, and more, can all be done through LynX at the point of application deployment. LynX supports end-user re-configurability of delivered systems for non-programmers. Several tools are provided with LynX to help the user specify a simulation. These include:

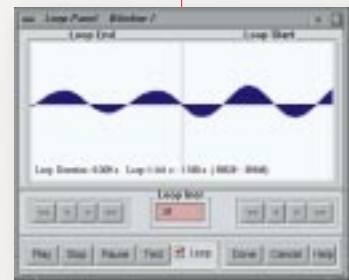
- An Object Viewer for examining individual objects referenced in the Objects Panel
- An Object Property Editor for viewing and setting attributes of object parts
- A Scene Viewer for looking at a Vega scene in top-down orthographic or perspective views and for examining coordinates within the scene
- An Input Device tool for testing and understanding the nature of the input devices defined in the Input Device panel
- A Path Tool for defining and editing paths along which objects or observers can move, as well as specifying object or observer speed and orientation along segments of those paths



AudioWorks2™

Vega includes AudioWorks2, which presents sound spatially in an open field, with continuous realtime waveform processing for multiple objects, earpoints and physical properties. It provides a physics-based anechoic rendering model that includes range attenuation, Doppler shift, and propagation delay. As visual objects are manipulated, the VegaAudio interface enables automatic positional changes, triggers, releases, and dynamic property changes. AudioWorks2 automatically re-prioritizes sounds, re-computes modeling parameters, and issues appropriate commands to sound rendering hardware, freeing the user from dealing with low level audio issues. When used with Vega and LynX, it offers a powerful, simple mechanism for quickly adding sound to any visual simulation environment. AudioWorks2 is bundled with Vega and LynX for IRIX and Windows NT operating systems, and is available in a stand-alone configuration for IRIX. AudioWorks2 for Windows NT operating systems, implemented using Microsoft® DirectSound™, also provides seamless interaction between visual and audio environments.

- Manipulate sound objects and listeners in an interactive, virtual 3D space
- Easy to use interface
- Realistic sound modeling and environment control
- Multiprocessing control
- Robust high level C language API for dynamic control
- Wave Editor, Wave Audition, and Object Sound Bead Parser within LynX



Vega Core Features

Vega Feature Summary

Modular realtime simulation environment
Includes Silicon Graphics Performer™ (IRIX)

Vega scene graph for NT
Future Fahrenheit scene graph support
LynX application development interface
AudioWorks2
Terrain Fade Level of Detail
Realtime execution kernel
Multi-pipe/multi-channel support
Multi-process support (Vega MP only)
System and database configuration files
Abundant sample source code
C language API
Professional documentation:
Vega Programmer's Guide (300+ pages)
LynX User's Guide (200+ pages)
Vega Utility Library
Support for optional modules
IRIX and Windows NT operating systems

LynX Features

X-Motif graphical user interface (Irix)
Intuitive, interactive operation
Active preview
Extensible
Re-configurable
Configures visual and audio simulations
Provides simulation performance analysis
Support for optional modules

AudioWorks2™

Realistic sound modeling and environment control
Presents sound spatially in an open field
Physics-based anechoic rendering model
Range attenuation, Doppler shift, propagation delay
Robust high level C language API

System

Multi-process support
CPU priority and assignments
Frame management
Asynchronous database manager
Asynchronous intersections

Graphics

Multiple graphics configurations
Fade level of detail
Level of detail scale

Windows

Multiple windows
Size and positioning
Multiple pipe support
Bitplane control

Channels

Channel positioning
Symmetric, Asymmetric, and Orthographic Frustums
Horizontal and vertical field of view control
Near and far clip plane management
Channel cull traversal sorting
Dynamic video resolution
Channel skew

Dataset Loader Support

Supports wide range of dataset loaders
Enables interactive visualization of many different data formats

On IRIX - compatible with any format that can be loaded into Performer™
On Windows NT - compatible with OpenFlight® and VRML 2.0

Observers

Eyepoint motion control
Look-at (observer tracking)
Channel share-groups
Scene load management
Stereo imaging

Motion Models

Initial/reset position
Default motions (Spin, Drive, UFO, Warp, Fly, HMD)
User-supplied motion model support
Multiple source input devices
Ground clamping

File System Search Paths

Relative and absolute directory specifications

Pathing Support

Linear and spline-based pathing
Static or dynamic pathing origins
Object or player relative pathing

Navigator Support

Built-in pathing navigator
Plug-in compatible with other modules

Database Manager

Flat Earth
Spherical Earth
Ellipsoid Earth (WGS-84 or user-defined)
Database origin (Cartesian or Lat/Long)

Players

Positioning control
Motion model selection
Coordinate system selection

Environments

Sky color
Fog type, color, and visibility
Spline fog support
Time of day control
Light source selection
Environment effect selection

Environment Effects

Five-layer cloud model
Infinite horizon clouds
Scudded and see-through clouds
Top and bottom cloud elevation control
Top and bottom cloud transition control
Dynamic moving clouds
Directional horizon glow
Ephemeris models
Ground fog
Storm

Lights

Five light type (Infinite, local, spot, sun, moon)
Ambient and diffuse color
Attenuation
Spot cone definition
Position

Volumes

Eight volume types

Isectors

Eight intersection methods
Twelve intersection result types
Immediate or deferred results
Local or world coordinate results
Intersection rendering
Class configurations

Color Tables

Direct insertion
No-Copy insertions
Support to 64K color tables

Terrain Fade Level of Detail (TFLOD)

Gradual transitions between different LODs
Elevation LOD scaling as height above terrain increases
Simple definition of TFLOD initial conditions and runtime operation with LynX

Tools

Object Viewer
Object Property Editor
Scene Viewer
Input Device Tool
Active Preview
Custom Statistics
Thresholds

Input Devices

Multiple simultaneous devices
Synchronous and asynchronous reads
Device scaling
Auto detection of serial devices
Serial communication control
Calibration and verification tools
Transmitter/receiver orientation

These input devices are supported through the XVS-SyncLink library by Xtensory Inc .

LynX and API support

- Ascension Flock of Birds
- Avenger Spaceball
- BG Systems Flybox
- HOTAS Adapter (PC serial devices; e.g. joystick)
- Intersense Tracker
- Logitech 3D Mouse
- Logitech CyberMan
- Logitech Space Control Mouse
- Origin Instruments DynaSight
- Polhemus Isotrak
- Polhemus Fastrak
- Precision Navigation Wayfinder (TCM2)
- Silicon Graphics Mouse
- Virtual I/O i-glasses!

API support

- Fifth Dimension Technologies 5th Glove
- General Reality CyberEye
- Immersion Probe and Personal Digitizer
- Spaceball 2003
- Virtual Technologies CyberGlove
- VPL DataGlove Model 2
- Wand

Modules

Vega is easily extensible, directly by the user or with application-specific modules, to satisfy special simulation needs. These modules deliver improved functionality and greater productivity in a range of simulation development areas.

Vega Special Effects

Pre-defined animation sequences, designed to simulate the appearance of certain dynamic visual effects, are hard or even impossible to render using standard database techniques. The Vega Special Effects module creates visual effects through various realtime techniques, from shaded geometry for non-textured machines to complex particle animations with texture paging, for the ultimate in realtime 3D effects. Vega Special Effects comes bundled with a large number of existing effects:

- Volumetric smoke
- Billboard smoke
- Fire/Flames
- Muzzle flash
- Flak
- Missile trail
- Rotating blade
- Tracer
- Explosion
- Debris
- Rotorwash
- Water explosion

Users may also define their own effects through the particle animation editor or through the API. The user may specify the size and orientation, start time, and duration of any special effect, attach it to a player or scene, and control many associated visual attributes. Effects can be configured to be visible under certain user-definable states -- for example, flames from an aircraft wing would appear only in the aircraft's "damaged" state. Special effects may repeat their animation sequence indefinitely, such as never-ending smoke from a smoldering fire, or may terminate, such as the flash from a gun barrel. Vega's particle system-based special effects also work with SensorVision™, providing accurate representations of special effects throughout the infrared spectrum.



Vega DIS-HLA

Vega DIS-HLA speeds the development of DIS and HLA compliant applications by extending LynX to provide DIS and HLA operations without any programming. VR-Link™, the leading DIS and HLA network interface software from MäK Technologies, is the DIS and HLA network communication foundation for Vega DIS-HLA, and is included with each license.

A mouse-click selection in LynX enables DIS or HLA capabilities and starts the broadcasting and reception of DIS or HLA data. A full ANSI C API for Vega DIS-HLA allows users to access the power of Vega DIS-HLA from their own code. Users can call Vega DIS-HLA functions directly from their C programs to handle entity information and to view protocol data units (PDU) in DIS, and interactions in HLA. Programming users may also directly call VR-Link functions to manage PDUs and interactions relating to collision, logistics, simulation management, emissions, and more.

- Simplifies the use of key runtime functions
- Simplifies application development
- Enables faster, easier networking
- Enables a fully DIS or HLA compliant simulation
- Provides the fully integrated benefits of VR-Link

Runtime Functions

Advanced PDU and interaction filtering improves performance by eliminating calculations for unwanted PDUs and entities, and improves simulations by reducing position changes when a PDU arrives. Three types of filters may be created:



- PDU/interaction filters that reject PDUs by their type, such as signal or detonation
- Entity filters that reject PDUs based on the entity they represent, such as all aircraft
- Range filters that reject or accept PDUs based on their range from a location

Multiple range filters can be created and attached to an entity.

Inbound entity type mappings with wild-card entries permit mapping to a single vehicle model for display.

Dead reckoning can be done automatically for all entities.

Coordinate system transformations between local and DIS/HLA coordinate systems are performed for all entities.

Stealth observers are fully supported and easily implemented using Vega DIS-HLA. Source code for a sample stealth observer is included with the product. Multiple stealth observers are supported, including detonation observers who view all detonations, wherever they occur in the simulation scene.

Graphics Tools

Entity-Appearance Editor - Relates the DIS entity state to a graphical appearance in the simulation. Vega's special effects, such as smoke and fire, can also be mapped to DIS attributes using the Entity-Appearance Mapping tool.

Articulated/Attached Parts Editor - Maps an entity object's part to articulations.

Munition Mapping Editor - Maps Vega's special effects to the firing and detonation of munitions, as reflected in fire and detonate PDUs/interactions.

HLA

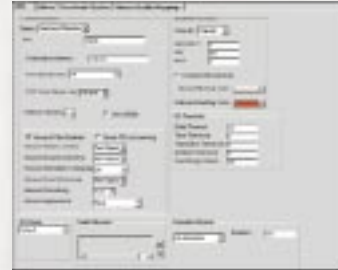
For HLA, Vega DIS-HLA provides easy-to-use support for the Realtime Platform Reference Federation Object Model (RPR-FOM). This HLA object model was developed by an industry consortium to aid in the transition from DIS to HLA by encapsulating the features of DIS. This also facilitates an API that is protocol-independent for the vast majority of operations. The RPR-FOM defines interactions that correspond to DIS PDUs. They can be accessed by your Vega DIS-HLA application in similar fashion to PDUs, using protocol-independent code. Vega DIS-HLA also provides routines to receive and easily decode object updates within HLA that correspond to EntityState PDUs in DIS, but are somewhat different in form.

Large Area Database Management™

The Large Area Database Management (LADBM) module makes it easier to work with large, complex databases. Vega LADBM defines and dynamically relocates a moveable database Ground Coordinate System (GCS) origin, using double-precision accuracy, so that it stays in close proximity to the Vega observer. This eliminates any jitter in the display when the simulated observer has moved far away from the initial origin of the database. Ultimate efficiency is assured through support for a user-definable Area of Interest (AOI).

LADBM keeps the observer centered in a sea of visual data, and lets the user set the size. LADBM works with Vega MP, so data can be loaded asynchronously by a separate database process. The management of geometry and texture between memory and storage devices occurs transparently to the user in realtime. LADBM supplies panels for the LynX graphical interface, making LADBM configuration quick and easy. LADBM insures high performance, ease-of-use, and efficient memory allocation.

- Simplifies working with large, complex databases
- Double precision accuracy
- Easily reconfigured using LynX
- Designed to work with Vega MP



Vega Marine™

Vega Marine provides special effects essential to realistic maritime simulation, making the development of maritime applications on UNIX and Windows NT platforms more productive and effective than ever before. All of the marine effects are controllable in LynX or via the C API.

Dynamic Ocean Models

- Realtime dynamic ocean modeled as a textured surface
- Wave heights and periods correspond to sea states
- Unique textures for each sea state.

Sinusoidal Wave Model

- Ocean surface modeled as a sum of up to 10 sinusoids
- Sinusoids derived from analysis of deep ocean wave fields
- Individual wave component's spatial frequency, propagation rate, and phase can be modified

Trochoidal Wave Model

- Multiple user-defined wave trains
- Wave train interaction creates true 3D surface
- Motion of ships and other floating bodies can be correlated to dynamic ocean movement

Wind Effects on Water

- Wind, represented as a local field vector, causes changes
- Trochoidal waves become steeper and point away from the wind
- Spray effect through whitecaps modeled as textured polygons

Stern Wakes

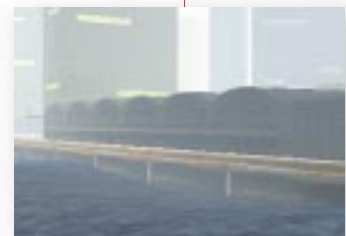
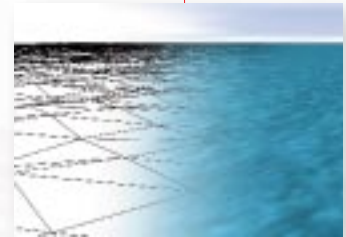
- Textured mesh draped on dynamic ocean surface creates wake
- Wakes widen and dissipate with distance and time
- Wakes follow a ship's motion through turns
- Wakes increase in length as ship's speed increases

Other Ocean Effects: Knuckle, Bow Waves, Eddies, Foam, Surf, Depth (Bathymetry) Effects, Sunlight on the Ocean

- Swirling texture in a ship's wake create knuckles, or turn positions
- Textured spray bow waves vary according to a ship's velocity
- Eddies model water flow around buoys and pilings; a field vector representing current specifies direction
- Foam on the ocean's surface can be simulated; translucent textures enable many different maritime effects
- Surf effect simulates waves breaking on the shoreline
- Depth information can be created off-line and used during marine simulations to affect color and behavior of ocean waves
- Sunlight on the ocean represents horizon glow and glare, affecting ocean color between sun and observer

Hoisted Flags

- Hoisted flags provide a signaling mechanism that can be attached to static objects or dynamic ships
- Ship's direction or local wind vectors orient flags



Optional Modules

Moored Buoys

- Moored buoys heave and pitch on dynamic ocean surface
- Library of navigation buoys included
- Create channel markers by combining buoys with the Vega Navigation and Signal Lighting module (VG-NSL)

Tow and Mooring Lines

- Lines are simulated as fixed length catenaries attached between two objects
- Lines are fully textured and scalable to any thickness
- Vega Marine provides a tension vector for both ends of the line as an input to the host's dynamics model

Lines (phone, fuel, tow, transport)

- Lines are simulated as variable length catenaries under constant tension, attached between two objects
- Lines are fully textured and scalable to any thickness

Crew Overboard

- Human figure floats in the water, waving his hands to draw attention

Flotsam

- Simulate floating objects that drift with the ocean current

Logs

- Simulates an object floating in the ocean
- Logs can remain below the ocean surface

Vega Symbology™

Vega's Symbology module meets the graphical status display and instrumentation needs of realtime engineering simulation and virtual reality systems. Pre-modeled graphical objects are automatically loaded into Vega as symbology objects using LynX. This autoloading technique is the easiest and quickest way to establish instrumentation and symbology display objects in Vega, taking advantage of existing models. An API is provided to create symbology objects entirely with Vega function calls, making this Vega module capable of controlling all types of graphics constructions as symbology objects. Elaborate clipping planes may be defined as control parameters, permitting overlapping and oddly shaped displays.

At runtime, a single function call controls each symbology object. Numeric and character strings are displayed in user-definable fonts, with left, center, right, and vertical justifications. Symbology objects may be scaled, translated and rotated in realtime. Objects with pre-defined degrees of freedom are automatically constrained to the pre-built minimum and maximum data values, such as a speedometer with a moving pointer. Vega Symbology enhances realism and conveys runtime information and status for realtime decisions.

- Optimized for speed
- Rapidly renders objects
- Switch node control of objects and parts
- Multiple masks permit complex screen changes and animations
- Fast, alphanumeric text readouts, dials, gauges, instruments, and symbolic graphics



Navigation and Signal Lighting (NSL)

The Navigation and Signal Lighting Module (NSL) enables the user to realistically render navigation and signal lighting systems using light points.

Light Point Type

A Light Point Type describes the physical appearance and rendering characteristics of a single type of light. A Light Point Type describes such things as the directionality, diameter, range, and visibility sectors of a light. Light Point Types can also be used to overcome the size limitations associated with raster light points by switching to textured polygons at close ranges. The texture used for this LOD feature can be changed to simulate various atmospheric effects, such as halos. NSL supports visibility sectors of up to 360 degrees in both the horizontal and vertical directions.

- Create, configure, and control light points within the Vega runtime environment
- Describe the appearance and signaling characteristics of a light point
- Maximum control over each light point in the database through multiple levels of aggregation
- Support for the rendering of calligraphic light points

Light Point Signal

Attaching light points to a Light Point Signal enables flashing. Input to a Light Point Signal can be provided through a Morse code string or a series of state (e.g. color and intensity) and time elements.

- Modify light point color and intensity
- Reduce the number of light points modeled to duplicate some lighting systems
- Use in conjunction with the light point phase characteristic to make strobes

Light Point Systems

NSL provides two levels of aggregation to provide better runtime control of light points: Light Point Systems and Light Point Groups. Light Point Systems consist of one or more light points that are contained within the hierarchy of a Vega Object.

- Provides runtime control over the state and intensity of its light points
- Can be assigned their own volume to providing more accurate culling

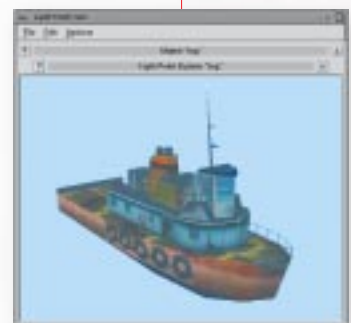
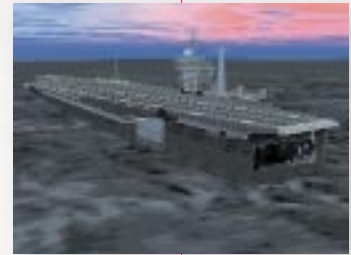
Light Point Systems for Vega objects with light points can be generated automatically at load time or as a pre-process. NSL also provides several pre-defined Light Point Systems that can easily be added to any existing Vega object:

- Approach Light Systems (ALSF-2, MALS, MALSF, MALSR, SSALR)
- Beacons (civilian, military)
- Glide slope indicators (PAPI, VASI-2, VASI-4, VASI-6, VASI-12, VASI-16)
- Runway End Identifier Lights (REILS)
- ALDIS
- FLOLS

Light Point Groups

Light Point Groups allow the state and intensity of multiple Light Point Systems to be controlled through a common interface. For example, all terrain lights in an entire database can be turned on or off through a single function call. The update process for a Light Point Group can also be spread out over several frames so as not to impact performance.

The user can add realism to Vega objects without light points with the LynX Light Point Tool or through the API.



Vega Light Lobes™

The Vega Light Lobes module uses a unique analytical technique that creates realistic scene illumination at all times of day, without the negative tradeoffs associated with hardware lights or projected textures. The observer must be near the source of the illuminating lights, such as the pilot of an aircraft with landing lights, or the driver of a car with the headlights illuminated. The workstation must have alpha planes provided in the frame buffer. Colored polygons represent the lobes if alpha planes are not available, permitting light lobes to be developed and tested on any suitably equipped workstation. Hardware lights meet other purposes, such as sun, moon, and street lamp lighting. Light lobes illuminate correctly at all simulated times of day and attenuate with distance without using black fog. Because this Vega module does not use projected textures, unwanted artifacts of texture do not appear in the sky or on the cloud skirt above the horizon.

- As many lights as you wish
- Clean and realistic display of projected light beams
- Variable intensity falloff outward from center of light beams
- Works with all visual databases without modification
- A LynX panel is provided that extends Vega's LynX graphical user interface
- API permits runtime control of light lobes



Non-Linear Distortion Correction (NLDC)

NLDC provides the capability to add static or dynamic distortion correction to any Vega application in minutes. Through the LynX graphical user interface, the user can create a software representation of the projection surface and establish the locations of the projector(s) and eyepoint within the dome.

NLDC assigns a grid mesh, automatically generated or user-defined, to each Vega channel. A ray trace and lens mapping process determines the location of the grid vertices on the projector object plane frame by frame, based upon the current projector and eyepoint positions. The Vega channel image is mapped onto the distorted grid as a texture. Each NLDC Projector takes one or more Vega channels as input and produces a single distorted image as output.

NLDC Alignment Tool

This enables the user to correct for geometric distortions in a projector image. The tool renders a test pattern consisting of a square target positioned on the surface of the dome at the azimuth and elevation of each LED in a user specified list. Each target is moved in azimuth and elevation to center it over the corresponding LED. The offsets required for the targets to superimpose the LEDs are then used to compute a correction to the projector lens map. The Alignment Tool can be run remotely from inside the dome on any X display.

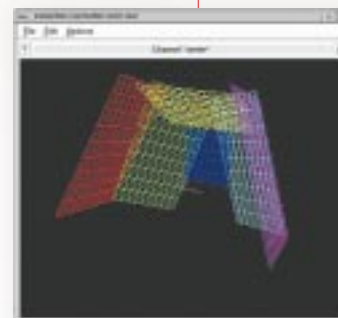
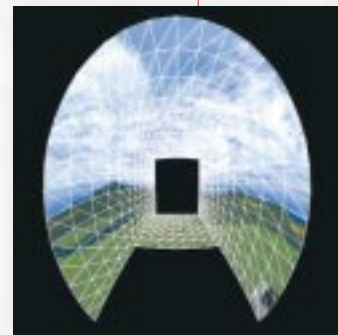
NLDC Grid Tool

The Grid Tool enables the user to create channel grids. These allow overlapping channels to be combined into a single projector image and edge blending to be incorporated between adjacent projectors. An extensive list of editing features greatly reduces the time required to create complex channel grids.

NLDC Viewer

The user can view an entire projection system in three dimensions by simply loading their existing ADF. The Viewer is both a handy debugging tool and is an excellent visual aid for presentations.

- Enables distortion-free projection of any database on an arbitrarily curved display
- Easy-to-configure display parameters
- Enables display upgrade without database re-design



Vega Class Recorder™ (VCR)

Vega VCR provides a point-and-click environment for easily recording and playing back scenarios, involving Vega classes such as objects, observers, players, special effects, and user-defined classes. A robust C API gives even greater control. Vega VCR has low overhead and uses asynchronous data recording. The user can also record interactive events, along with playback of pre-recorded scenarios into a complex composite scenario. Recordings may be frame-based or interpolation-based (the maximum sampling frequency is configured in Hz and is relative to the targeted frame rate).

- Play a scenario
- Fast forward
- Rewind and play it again
- Jump immediately to any location in the scenario
- Play back several pre-recorded files simultaneously and in parallel

Complex simulations can be recorded by adding one vehicle at a time. Similarly, the playback timeline of individual pre-recorded VCR files can be controlled to adjust timing. You can record position, state and property changes for the following:

- Observers
- Players
- Objects (including dynamic addition and removal from the scene)
- Parts
- Environments
- Environment Effects
- Graphic States

The Vega product modules Special Effects and Light Lobes are also integrated with Vega VCR.



CloudScape™

CloudScape VR™, developed by Visidyne, Inc. provides quantitative, radiometric, 3D cloud rendering in realtime. It offers visualization of weather clouds, munitions, bomb-generated dust clouds and other battlefield environments when used with a supporting cloud phenomenology module or database.

- Simulate realistic battlespace environments
- Create quantitative input for FLIR and SWIR sensor evaluation
- Enhance instrument-based tactical training
- Anticipate visual effects of weather

CloudScape VR is integrated with Vega and the SensorVision module. It executes on Silicon Graphics computers, achieving realtime performance on a Silicon Graphics Onyx2 with InfiniteReality graphics.

Feature Highlights of CloudScape VR

- Realtime display of clouds in user-selected waveband (visible, infrared, or ultraviolet)
- Displayed images are color mapped from quantitative radiometric images using the same grayscale as SensorVision
- Clouds are modeled as fully three dimensional and rendered as polygonally faceted surfaces
- Cloud images include the following reflections:
 - sun
 - sky
 - earthshine
 - emission of thermal radiation
 - transmission of sunshine
 - transmission of background radiation
 - multiple scattering effects



Image courtesy Visidyne, Inc.

Relationship of CloudScape VR to Other Tools

CloudScape VR visualizations start with a faceted description of cloud radiative properties. These radiometric databases for describing weather clouds are prepared with the CloudGen™/Weather Toolkit. The process starts with the generation of 3D descriptions of cloud condensed water content by using combinations of physics calculations and fractal techniques, or by translating outputs of U.S. Government-developed models. The cloud surfaces are faceted, and at each facet vertex, the integral form of the radiative transfer equation is solved. Single scattering is calculated exactly and multiple scattering is approximated using a validated technique developed by Visidyne. CloudScape VR also utilizes a database of atmospheric radiative properties. The CloudGen/Weather Toolkit contains a tool for generating these atmospheric databases using the DoD-standard Moderate Spectral Atmospheric Radiance and Transmittance Program (MOSART). For consistency, atmospheric databases generated with Vega SensorVision's MOSART Atmospheric Tool (MAT) may also be used.

Vega DI-Guy™

DI-Guy™, developed by Boston Dynamics, Inc., has been fully integrated into MultiGen-Paradigm's Vega toolkit to create Vega DI-Guy. Vega DI-Guy™ adds life-like, automatically animated human characters to simulated environments. Each character moves realistically, responds to simple commands, and travels about the environment as directed. Even when switching from one activity to another, Vega DI-Guy makes seamless transitions and moves naturally. Vega DI-Guy software achieves outstanding realtime performance through optimizations such as motion caching, variable motion interpolation, level-of-detail switching, motion level-of-detail switching, and task-level control.

- Specify behavior through LynX panels or through the DI-Guy API
- Select characters, clothing and equipment
- Assign behavior and control travel throughout the environment
- Display dozens of articulated Vega DI-Guy characters at one time.

The Vega DI-Guy option includes a set of dismounted infantry characters using authentic military behavior based on the motions of trained soldiers. The soldiers have fully textured models in seven levels of detail, several uniforms (Battle Dress, Desert Camouflage, Land Warrior II, Iraqi Green), weapon types (M16, AK47, M203), and a variety of auxiliary equipment (backpack, canteen, bayonet, IHAS, etc.) Behavior includes standing, kneeling, going prone, walking, jogging, crawling, sneaking, using a weapon, and other activities. Other available characters include FDC-Guy (flight deck crew, plane captains, and landing signal officers) CB-Guy (chemical/biological warfare characters) and PED-Guy (pedestrians). MultiGen-Paradigm can also supply custom-made Vega DI-Guy characters as needed.

Vega DI-Guy Applications

- Ground Warfare
- Small Unit Operations (SUO)
- Military Operations in Urban Terrain (MOUT)
- Operations Other Than War (OOTW)
- Non-combatant Evacuation Ops (NEO)
- Tank and Gunnery
- Flight Deck Operations, LSO
- Mission Planning / After Action Review
- Pedestrians for Driving Simulators
- People for Urban Simulation



SimSmith Vehicle Objects

SimSmith Vehicle Objects (SSVO) is the first module in SimWright's SimSmith line of Vega extension modules. Vehicle Objects extends the Vega visual simulation library by allowing the developer to build hierarchies of objects and by articulating parts of objects. Vehicle Objects enables programmers or non-programmers to rapidly create realistic objects to populate the virtual operating area. The module includes graphical tools that allow creation of complex model articulations and attachment of objects, special effects, and observer points without complex code.

- Simplify building of object hierarchies and articulate parts
- Easily group multiple objects into a single higher level object
- Attach or detach objects from hierarchy as needed
- Connect entities such as observers, players, and isectors to object attach points
- Control systems of assembled parts by a single function call

Vehicle Object Editor

The Object Editor is a graphical LynX tool that allows the user to create attach points on objects, set offsets for objects, and attach players, observers, lights, isectors, special effects, and other objects to attach points on an object. The Vehicle Objects Editor makes it easier than ever before to group multiple objects together into a single higher level object. Other objects may then be attached or detached from that hierarchy. Entities such as observers, players, and isectors may also be connected to attach points on objects. When an object is positioned in the virtual world, all "children" attached to it are positioned correctly. This feature simplifies attaching special effects or observers to articulated parts of an object.

Vehicle Articulation Tool

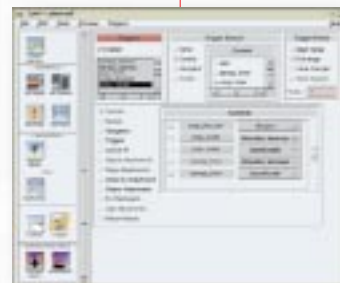
The Vehicle Articulation Tool is a graphical Lynx tool that allows the user to rapidly configure and group individual articulated parts into a single related system without programming, using a point and click user interface. The individual articulated parts may be rotated or displaced about any axis. Either simple or reciprocating motion is possible.

SimSmith Vehicle Controls *(available during 1999)*

SimSmith Vehicle Controls (SSVC) is the second module in SimWright's SimSmith line of Vega extension modules. Vehicle Controls extends the Vega visual simulation library by allowing the developer to incorporate event-based actions into Vega applications. Vehicle Controls has a robust API that may also be accessed via Lynx panels to graphically script a wide range of actions without coding. Vehicle Controls is tightly integrated with Vega, and gains additional capabilities when used in conjunction with SimSmith Vehicle Objects.

Vehicle Controls introduces to Vega the concepts of controls and triggers. Controls can be timers, keyboard input, or Vega input devices, and may also act as a mapping transform for another control. Triggers allow a series of actions to be initiated when an event occurs. Events are generated from Navigator waypoints, state change of another Control, or an Isector hit or miss. A single trigger may initiate any, all, or multiple instances of each of the actions. The actions allowed include the following:

- Start/stop a special effect, audio sound, missile motion model (bomb, guided or unguided missile)
- Position a Vehicle Objects articulation
- Start/stop/reset a timer Control or Navigator
- Initiate additional triggers
- Attaching/detaching of Vega objects, special effects, observers, players, lights or isectors to other objects when used with Vehicle Objects



Vega Immersive

Vega Immersive takes Vega features that enable operation in a fully immersive environment with multiple observers, and consolidates them into one module with a graphical Lynx panel. Vega Immersive supports any number of walls or projection surfaces in a CAVE™ or other multi-display environment. Each projector runs at 120 Hz, and draws a left eye and right eye image. Vega allows the user to define any number of windows, with multiple channels per window.

- Head tracker updates viewing frustum automatically
- Easy one-time configuration for your specific hardware
- Ideal for manufacturing assembly
- Includes ImmersiveLib0 environment
- Full Vega API and LynX GUI support
- Supports stereo viewing devices
- Runs under IRIX0 or WindowsNT0
- Runs on SGI or Intel-based computers
- Supports multi-processor systems
- Supports multiple display channels
- Supports wide range of input/control devices
- High performance, low processing overhead
- Compatible with other Vega modules



" MultiGen-Paradigm and Vega have allowed us to become a significant player in the field of visual simulation, by giving us cost-effective and powerful tools that enable our organization to meet customer demands and reduce project costs and timeframes."

Kevin McClure, Quality Research

"Vega's rapid prototyping capabilities enable us to effortlessly set up complex virtual testbeds for our realtime behavior technologies."

Frederic Francis, Lateral Logic Inc.

" The combination of MultiGen-Paradigm tools has allowed us to efficiently meet our realtime visual simulation needs. By creating and modifying our database within MultiGen, we were able to quickly gain access to and control objects using the Vega API."

Wyck Hébert, Lead Engineer, CLCS 3D Vis-Sim Project, NASA

" Using MultiGen-Paradigm tools including Vega during the development of photo-realistic scenario images contributed a significant improvement in realism of battlefield training and simulation applications, while reducing project costs and schedules."

Yoram Vishlizki, Director, New Systems Development, C4I Systems and Simulators, Rafael

Other MultiGen-Paradigm Products

Vega and its optional modules form an integrated part of the MultiGen-Paradigm product line for IRIX™ and Microsoft Windows NT® operating systems. We offer an industry-leading range of highly automated realtime 3D database development and visual and sensor simulation tools, including the MultiGen Pro series and MultiGen Creator™.

The MultiGen Pro series brings unsurpassed efficiency and productivity to database generation with a unique blend of polygonal modeler, hierarchy editor, vector modeler, and terrain skin creation in one integrated package. The MultiGen Pro Series includes:

MultiGen Creator™

MultiGen Creator and its options combine robust modeling tools with an accessible, intuitive interface: a high performance, end-to-end solution for interactively developing realtime 3D applications.

CreatorPro

A highly automated realtime 3D modeling and assembly system for building models such as aircraft, vehicles, buildings, and specific areas of high interest, including city centers and airfields.

TerrainPro

The most productive way to create accurate large area terrain databases with high-fidelity 3D culture and imagery.

RoadPro

Designed for rapid generation of roads that meet strict real-world engineering standards for applications such as driving simulations, driver training, and accident re-enactment.

Interoperability Tools

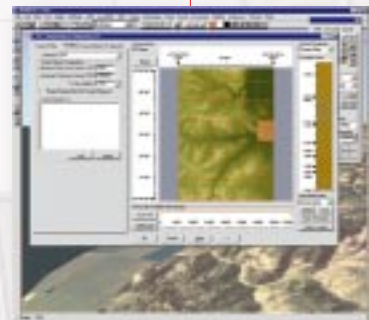
A suite of Interoperability tools for exchanging defense data format source files.

OpenFlight

MultiGen-Paradigm also developed and supports the industry standard realtime 3D file format, OpenFlight.

Sensor Simulation Tools

MultiGen-Paradigm, in partnership with Photon Research Associates, develops a comprehensive array of sensor simulation products that includes Vega SensorVision™, SensorWorks™, and RadarWorks™. These extensible modules plug into Vega™ and use the same synthetic environments as Vega to provide correlated out-the-window, infrared, and radar views.



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THE REALTIME 3D COMPANY



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