Take Flight
THE OFFICIAL NEWSLETTER OF MULTIGEN-PARADIGM

VOL. 6 WINTER 2001

# Continuing the tradition of innovation and customer satisfaction

By Sandeep Divekar
President and General Manager

In this, my first ever President's message, it is my pleasure to introduce myself and discuss some of the exciting activities going on inside MultiGen-Paradigm. I am taking responsibility of MultiGen-Paradigm as President as a result of Dave Rolston's departure. Dr. Rolston has done a tremendous job building the operation, supporting partners, and the visual simulation community. I am very excited to join MultiGen-Paradigm at a time when the company is experiencing a strong wave of success and to work alongside a very talented and committed team.

Over the past two years, I've been Senior Vice-President for Visualization Strategy at Computer Associates. Prior to joining CA, I was formerly CEO and co-founder of 3Name3D Inc. which was acquired by Computer Associates in October 1998. I'm fortunate to have a strong background both academically and in the industry within the graphics business. I've been actively involved in 3-D graphics since 1986. I have also taught at the University of Southern California since 1994.

Enough about me, let's talk about the future for MultiGen-Paradigm. This year we have experienced success with both the service projects and our commercial off-the-shelf products. In particular, MultiGen Creator, Vega, and Sensor products released new versions of the products. These products released with new features, updated documentation, and completely new packaging. All of these updates came directly from input from our customers. We have a strong tradition of putting our customer first and we will continue to uphold that tradition.

We have also seen the services business growing at a rapid pace. From major initiatives with Lockheed Martin, Boeing, SGI, EDS, US Army, and US Air Force, our services team continues to enjoy success. Ultimately, these successes result in better commercial products. This cycle of innovation is critical to our future. We've also made some exciting progress in the area of urban simulation. Most recently, we've announced a partnership with the City of Toronto to assist with the Olympic bid for 2008.

Many people have asked me, "what is next for MultiGen-Paradigm?" We plan on continuing our support for the visual simulation community. In particular, you will see us more active on industry initiatives and collaborating on the next generation technology. We continue our focus on the development of industry leading technology and helping to improve the training systems so that our customers can build the most compelling simulation applications possible. Our new marketing slogan puts it best: Real life. Realtime. As real as it gets.

We understand that each of our customers require life like fidelity with realtime performance. We will always deliver on the promise of exceptional customer satisfaction. I guarantee that we will leverage our heritage while supporting you, our customers and partners, with innovative solutions.

I'm looking forward to meeting with each of you very soon.

MultiGen · Paradigm
THE REALTIME 3D COMPANY

# What's New

## Creator Update

By Todd Griffith
Product Manager, MultiGen Creator

Hello MultiGen Creator Users!

The second half of 2000 was a very eventful and busy six months for MultiGen-Paradigm and MultiGen Creator. I would like to take a few moments to update you on recent events and releases for MultiGen Creator, as well as give you a short preview of the exciting things coming in the near future.

First off, the acquisition of MultiGen-Paradigm by Computer Associates is felt positively with the release of MultiGen Creator 2.4 on Windows back in August. This version of MultiGen Creator supports Microsoft Windows® NT 4.0, Windows 98, as well as the first version of MultiGen Creator to explicitly support Windows 2000. Being a part of Computer Associates affords the MultiGen Creator Product Team the opportunity to re-design and improve our product documentation to better reflect customer needs. The information from the User's Guides was added to the online help system in MultiGen Creator, enhancing the reference-based information that it provides. In place of the hardcopy User's Guides, we have replaced them with what we describe as "concept guides" for both object modeling and terrain generation. These guides both assist the novice and the experienced user with tips, techniques, rules of thumb, and explanation of use cases. The concept guides are designed with customer feedback in mind. If you have any suggestions or tips for inclusion into the next revision of these books, please contact John Perser at john.perser@ca.com. In addition to the new features and documentation in MultiGen Creator 2.4, we also have modified the licensing to allow for network-based floating licenses on Windows platforms. Customers on IRIX have always had this capability, and now it is persistent across both platforms. An often-requested benefit, you can even have a single license server configured for simultaneous administration of your SGI IRIX and Microsoft Windows-based Creator modeling workstations. This change should allow you both greater flexibility and easier license administration. All new customers receiving MultiGen Creator 2.4 will have floating licenses automatically, but long-term users on maintenance will need to contact support@paradigmsim.com to upgrade their licenses and configuration requirements.

While you may be updating your license for floating on a network, if you own the basic MultiGen Creator configuration, you will also want to update your license for some additional functionality. As long as your MultiGen Creator licenses are under a current maintenance contract, you are eligible for a free upgrade from v2.3 or earlier to include the former Power Option and BSP Option. These product options used to be for additional cost, and give you advanced modeling (extrusion), texturing (4-point put, 8-point warp) structure editing (Binary Separation Planes) and many other tools. This new product configuration was launched with MultiGen Creator 2.4, and is our way of saying "Thank You" to our loyal user base.

In addition, we have made MultiGen Creator much more affordable across the full product line, from base MultiGen Creator to Terrain Pro. Contact your regional MultiGen-Paradigm sales representative or distributor for more pricing information.

Last Fall, as evidence of our commitment to provide robust and solid software tools, we have released a handful of software patches for MultiGen Creator 2.4 on Windows. They are available for download from www.multigen-paradigm.com. They repair some issues that did not make it in the final release of v2.4, as well as address some valuable customer feedback after the release. These patches represent our ability to be more responsive to our customers and to be more nimble in the marketplace. Every significant release of MultiGen Creator scheduled in the future will contain "patch time" in order to achieve these goals. One added benefit for MultiGen Creator on IRIX customers is that although the IRIX release of v2.4 follows the Windows-based release chronologically, the IRIX platform version contains all of the general fixes from the Windows version automatically.

Through January 2000, we have released MultiGen Creator 2.4.1 for both Windows and IRIX. This maintenance release is focused on product optimization and solid operation, bundled with some additional capabilities. A new data interoperability option on Windows is the MultiGen SEDRIS Exporter. This option will generate a user-defined SEDRIS Transmittal File (.stf) from OpenFlight, either as a stand-alone command-line utility, or as a plug-in to the MultiGen Creator interface. Contact your nearest MultiGen-

## What's New *(continued)*

Paradigm sales representative or distributor for availability and pricing.

Look to the MultiGen-Paradigm website for PFtoFlight, which is an interface utility to SGI Performer libraries for file interchange between OpenFlight and any file format that Performer supports. It's a nifty and convenient little utility on the IRIX platform.

Also be on the lookout on the MultiGen-Paradigm website for us to post a backlog of Plug-ins for MultiGen Creator. We will be putting up some new MultiGen Creator plug-ins generated from our own development team, as well as the first third-party plug-ins of the program. The third-party plug-ins scheduled for posting include a Boolean operation and texturing plug-in from Geometric Computing, and new file format importers / exporters from StrataSim (www.stratasim.com).

Remember, if you are a new user, or an experienced user looking for a refresher and introduction to the new features, a training class on MultiGen Creator 2.4 may be right up your alley. There are plenty of classes to choose from, but you will want to reserve your seat early, as placement does fill up fast.

I sincerely hope that you have enjoyed the new benefits and new look-and-feel of the MultiGen Creator product configuration (including a packaging re-vamp).

Once again, thank you for your valued use of your creative talents with MultiGen Creator. If you have any questions or suggestions regarding MultiGen Creator, please feel free to contact me at your convenience at todd.griffith@ca.com.

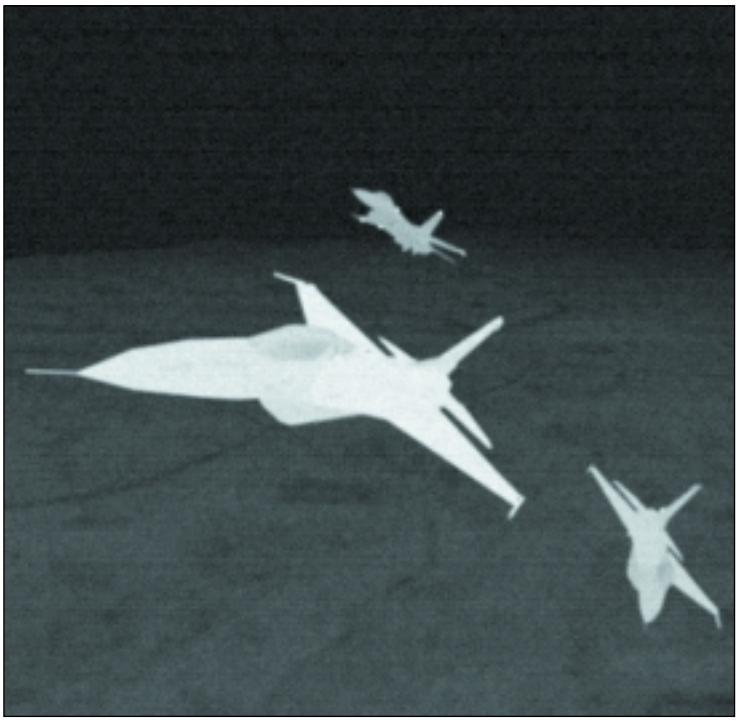
## Vega Update

By Christian Cole
Product Manager, Vega

What's Happening In The World Of Vega?

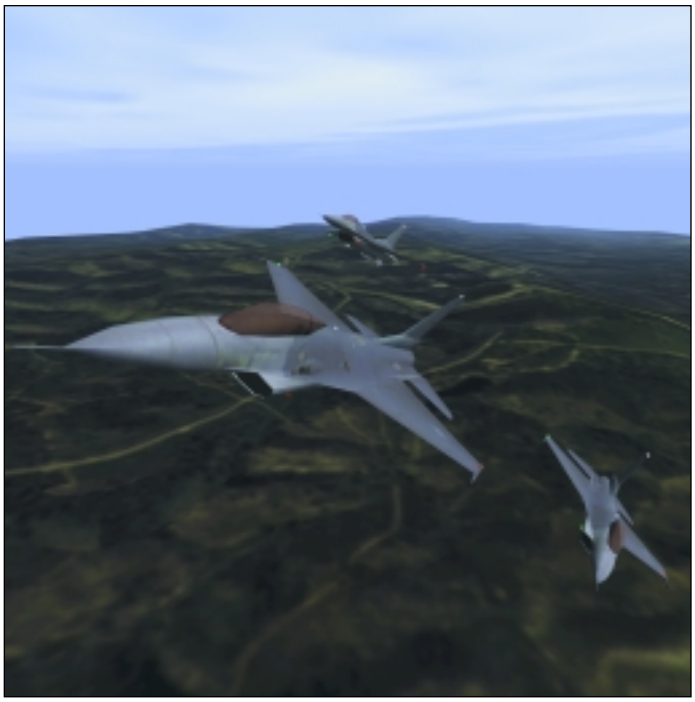
Hello everyone, before I start telling you about all things Vega, let me take the time to introduce myself for those of you who I haven't had the chance to meet. My name is Christian Cole, and since April I have been the Product Manager for Vega. I have been with MultiGen-Paradigm for over 6 years now, and am extremely happy to have been given the opportunity to manage a product with such a diverse customer base. For the past 6 years many of you may have seen me pushing a mouse (the 3 button kind) around one of the many trade shows we exhibit at. Here at MultiGen-Paradigm, I have been the Systems Engineer (SE) for the Western Sales Territory, as well as the SE Manager. It was good to see many of you at the recent I/ITSEC trade show in Orlando, Florida.

There has been a lot of excitement here at MultiGen-Paradigm recently, and we have much to talk about on the product front. First of all, those of you who are new customers or are currently on maintenance will have received your Vega 3.6 software updates. Starting with Vega 3.5, we have also entirely redesigned the packaging and documentation. We are very excited about this change, and think you will find these new books to be a very worthy addition to your bookshelf! Among the many new features we have included in the most recent versions of Vega are Distributed

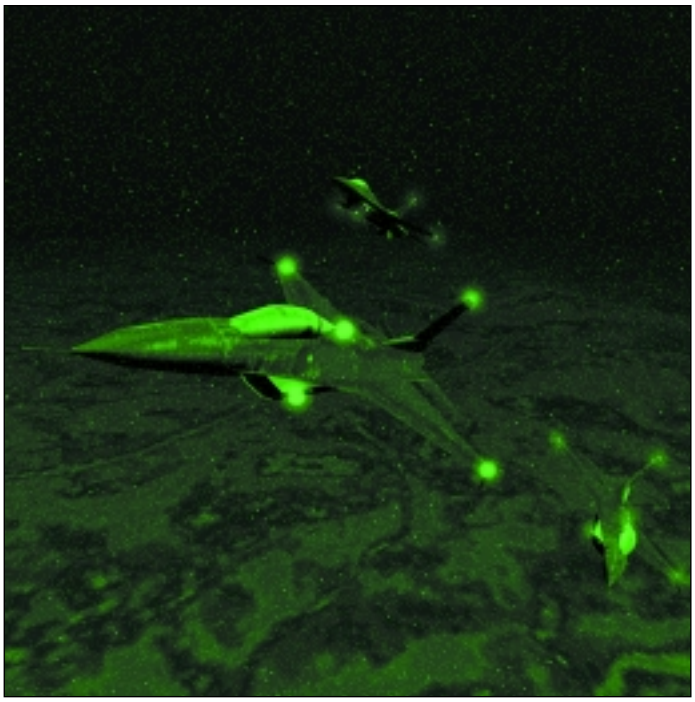


Realtime physics-based Infrared simulation

## What's New *(continued)*



Compelling realism out the window



Quantitatively accurate sensor simulation

Vega, Virtual Texture support, and Night Vision Goggle effects. If you have any questions about these, or any of the other new features in Vega 3.6, please feel free to contact us and we'll be happy to talk to you about them.

Another exciting change has been Vega's new pricing structure, many of Vega's optional modules, as well as many of the Runtime Licenses have been reduced in price. We have also now included the Vega VCR Module with both the NT and Irix versions. If you are a maintenance customer and want to unlock the VCR Module, please email your license information to support@paradigmsim.com. Some of the things we're working on for upcoming releases include OpenFlight Loader enhancements, support for SGI's Performer 2.4, and of course Vega Linux.

Finally, you may have noticed a large number of updates coming your way recently (3 updates in the last 5 months!). Here at MultiGen-Paradigm we are very hard at work increasing the frequency of software updates. The most current software revision for all platforms at the time of this article is Vega 3.6.

Well, that's it for now. As always, thanks very much for your use of MultiGen-Paradigm products. Keep those enhancement requests coming, and please let me know if you have any feedback (good or bad) regarding the new packaging, documentation, Vega 3.6, or anything else related to the Vega product line. Thanks, see you at the next trade show!

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# The Move Towards Higher Fidelity in the IR Sensor Simulation Products

By Michael Matuson
Senior System Analyst

So, do you want it fast, or do you want it accurate? This question has been haunting sensor simulation designers since the beginning. The answer always depends on the end use of the simulation and the cleverness of the simulation designers.

Technological breakthroughs such as developing a method for generating infrared (IR) images within the confines of the graphics pipeline, and integrating data from high-fidelity tools such as MOSART and TERTEM have raised the bar for producing IR simulation that is both good and fast. Advances in graphics hardware and CPU technology have also helped advance the MultiGen-Paradigm products down the good-and-fast path.

The MultiGen-Paradigm sensor simulation products, SensorVision for IR scene modeling and SensorWorks for IR sensor modeling, have direct lineage back to the visual simulation (vis-sim) domain. When conflicts arose, the real-time requirement generally took precedence over the fidelity requirements, since frame rate was, and often still is, a hard requirement.

It is becoming more common now to find customers who wish to use the sensor products in an environment other than vis-sim. For many of them, accuracy becomes increasingly critical, to the point where real-time requirements can be relaxed and the balance tipped in favor of fidelity. For these customers, and for the future in which we see more customers looking for accuracy, we have been pushing the IR sensor product development down a path of increased flexibility with the goal of providing the customer with the ability to trade speed for accuracy at will.

## SensorVision

The IR scene modeling simulation module, SensorVision, has always relied on the external high-fidelity IR modeling tools MOSART and TERTEM to generate realistic data. Integrated together and named MAT, the MOSART Atmospheric Tool, data is generated offline and used to build a database which SensorVision draws on to render accurate IR scenes. Band specific, per pixel exitance (or emittance) values are quantitatively computed in units of dBsm (decibels referenced to one square meter). Atmospheric attenuation is taken into account producing a quantitative view of the IR scene at the aperture of the sensor. Figure 1 shows an example of the output of SensorVision.

Figure 1. A SensorVision Output Image

SensorVision has been designed with the concept of the fidelity-speed trade-off in mind. It offers the user several modes of operation in which speed increases can be traded for accuracy.

First is the temperature modeling approach. Object temperatures vary as a function of time-of-day and observer line-of-sight. For the fastest performance, these temperatures are calculated once per GeoSet, that is, once per collection or “set” of geometry, in Performer terminology. If more accuracy is needed, then the updates can be calculated once per vertex, a solution which obviously requires significantly more computation since there can be many vertexes in a GeoSet. The choice of which solution to use is given to the user to make.

Choosing the per-vertex approach requires that the user make another choice. In IR scene modeling, there are two key terms that can contribute to the total exitance: the reflective component and the emissive component. With the per-GeoSet method chosen, SensorVision can compute both of these components in a single rendering pass. With the per-vertex option, however, two rendering passes are required. This slows down the simulation, but improves the accuracy of the solution. To mitigate this, the user is given the option of choosing to solve for one component or the other, in which case the rendering reverts back to single-pass. For near-IR systems, for instance, the user may choose to solve for the reflective component only, while for far-IR system, the choice of computing the emissive component only may provide sufficient accuracy. The bottom line is that the user is given the choice and is in charge of determining the suitability of each option.

*(continued on page 6)*

# The Move Towards Higher Fidelity in the IR Sensor Simulation Products *(continued)*

Figure 2. SensorWorks Simulation of a LWIR

One last option is available. In cases where both the reflective and emissive components are needed, the user may choose to sacrifice time-of-day variability by choosing to use the "radiance texture" approach. Radiance textures are pre-computed and include both components, but the act of pre-computing strips the solution of the ability to change as a function of time-of-day. For modeling short periods of time, this may be perfectly acceptable.

## SensorWorks

Until Vega 3.5 was released, IR sensor modeling was limited to a vis-sim solution only. The user was given only enough control to tweak the sensor output image to "look" correct. The pains taken to maintaining fidelity in SensorVision were lost once the image was handed over to SensorWorks. Vega 3.5 has introduced a change in philosophy by offering the user two interfaces to the sensor model.

The first is the vis-sim interface. It has been updated from its older incarnation making it more understandable. Its purpose has not changed: Provide a vis-sim level-of-fidelity interface that allows the user to tweak the image to look correct.

The second option is more sophisticated. It is designed to add quantitative credibility to the solution. This analytical interface presents the user with the ability to insert typical sensor parameters by value. SensorWorks translates these parameters into quantities that it needs and produces a quantitatively accurate sensor image at its output. These parameters include:

- *Oversample Ratio*
- *Aperture Size*
- *Optical Obscuration Ratio*
- *Defocus Error*
- *Aberration Blur*
- *Average Normalized Detectivity (D*)*
- *F-Number*
- *Optical Transmittance*
- *Detector Angular Subtense*
- *A/D Bits*
- *Display Bits*
- *Noise Factor*
- *Reference Background Temperature*
- *A/D Gain*
- *Processing Factor*
- *Detector Bias*
- *Temporal Noise Ratio*
- *Scan Direction*
- *Serial Scan Ratio*
- *Number of Detectors / Pixel*
- *Field of View*
- *Line Noise*
- *Scan Efficiency*
- *Overscan Ratio*
- *Number of Fields / Frame*
- *3 db Bandwidth of the Electronics*
- *Number of Detectors*
- *Detector Pitch*
- *Serial Scan Ratio*
- *Frame Rate*

Scanning, staring and micro-scanning systems are all supported by this interface. Figure 2 shows a sample image produced by SensorWorks modeling a long-wave infrared (LWIR) sensor looking at the same scene shown in an earlier figure.

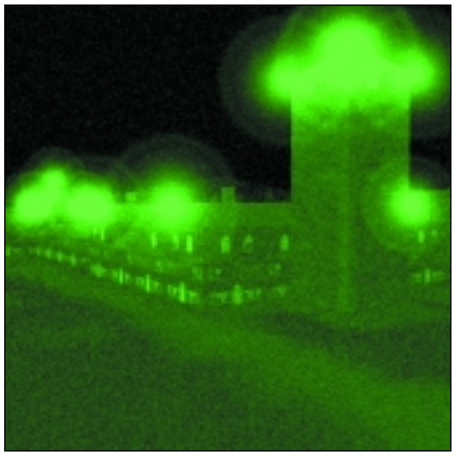

Figure 3. SensorWorks Simulation of NVGs

There have also been some new features added to SensorWorks to encompass a wider variety of sensors. One example is Night Vision Goggles (NVG) which operate in the near-IR band. Figure 3 shows sample output from SensorWorks which has been programmed to simulate NVGs.

## The Future

One key goal in the development of the IR sensor products has been to recognize that sensor simulation is a discipline that has many demands on the fidelity-speed trade-off. There is probably no way to satisfy the needs of all users. Adding flexibility to the products, in essence putting the user in charge of making trade-off decisions, widens the applicability of the tools.

The new analytical SensorWorks interface and the new capabilities introduced in the latest release, in conjunction with the SensorVision fidelity controls, offer the user a technically credible solution to producing IR sensor images. But the problem is large and there is always room to do more. Where the products go from here will largely be driven by customer needs.

# Alternate Color

## The under used, memory saving attribute

By Dan Oller
MPI Technical Support

When dealing with real-time computer graphics, anything that can save you memory, especially texture memory, is worth taking a look at. What if I told you that I know a way to cut the number of textures you use in half, and those textures that you do use need only be black and white images? This is all possible, once you learn to harness the awesome power of Alternate Color.

The alternate color of a polygon is used for coloring intensity imagery. Intensity images (SGI .int and .inta files) are made up of black, white and shades of gray. Once these images are brought into MultiGen Creator, they can be applied to a polygon, then, using primary and alternate colors, you can color the image.

Pure black on an intensity image will be colored with 100% primary color. Pure white will be 100% alternate color. Every shade of gray between white and black will be a blend of the two colors. Any alpha in the texture file will retain its transparency.

For the process to work properly, you will have to make sure that the Texture Environment (in the Texture Attributes page for the image) is set to Blend. This setting will let the software know that you want the primary and alternate colors to blend, depending on the intensity of the given texture.

Vertex colors are used in addition to alternate color. If you have a polygon with an .int texture on it, primary and alternate colors plus a vertex color on any given vertex, you will see all of the colors blending properly. One thing to note is that when MultiGen Creator renders a polygon, it first looks at the face color and vertex color, then the material, and then the texture to get the final appearance of the polygon. The alternate color is applied in the third stage, when MultiGen Creator looks at the texture (because alternate color is dependent on the intensities of the texture). This causes the vertex color to only affect the primary color, not the alternate color (since it has not been rendered at the time vertex blending is being calculated).

All lighting modes will show you a polygon with primary and alternate colors, however to get the vertex color to come through you'll need to be in either Gouraud or Lit Gouraud shading mode.

Materials work fine with alternate colors as well. Again, the material will only affect the primary color because at the time the material is drawn, the alternate color has not yet been applied to the polygon. Materials only work when you are using Lit or Lit Gouraud shading. So if you want to use vertex coloring and materials, you'll need to work in Lit Gouraud mode.

The art of using alternate colors can be very useful if you have a model that needs to be textured with very similar textures that differ only in color values. For example, if you wish to create a forest of trees, you could take one tree image, apply it to a polygon, and copy the polygon over and over to create a forest. Unfortunately, this looks unrealistic to the end user, no forest is made up of trees that look the exact same, even if you are flying over the forest, you need some difference in colors to make the forest look real. You then decide to create four different tree textures, each a different shade to make your scene look a little better. This works great, but now you are using four (or more) .rgb images, which can get fairly large.

This is a perfect time to use alternate colors. Take your tree image into your favorite image editor and remove the color information from it. Save your tree image as an intensity file (see Figure 1).

Figure 1. Intensity tree image

Use this new image to texture your forest, and vary the primary and alternate colors to create your life-like forest. I have done just that to show you how well this can work for you. The final image (shown in figure 2) was created within MultiGen Creator 2.4, using one intensity image and making four different versions of the tree by changing primary and alternate colors (versions of MultiGen Creator previous to 2.4 did not fully support alternate colors). The intensity image I used was 38.2 KB, when it was an .rgb image it was 100.0 KB. Had I used four .rgb images I would have used 400 KB of textures; with the one .int image I reduced this by just over 90%.

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# Alternate Color

## The under used, memory saving attribute *(continued)*

Proper use of alternate color will reduce texture creation time, and make it a whole lot easier to make those last minute changes - because you are only working with one image, not several. This can save disk space as well, especially if you are using large images.

It will also help when you take your model into your runtime. Using fewer images will save on load time, plus create a less memory intensive model. Go ahead, try it today using MultiGen Creator and Vega, nothing is holding you back. If Vega is not your runtime, please make sure that your runtime and runtime loader both fully support the blending texture environment required for correct use of alternate colors.

Figure 2. Forest created by use of one .int texture and alternate colors runtime-friendly model.

Properly utilizing the alternate color of polygons will save you time and effort, and will lead you to creating a more runtime-friendly model.

## Meet the New International Sales Manager

By Michael Sivret
Manager,
International Sales

This is a homecoming of sorts having spent 3 years as the Southeastern Sales Manager working in Orlando Florida. I have to be honest in saying that working for Multigen back then was one of the most rewarding jobs I've held. So I was quite excited when I was asked to return to assume the role of International Sales Manager. Having spent the last two years in the same role with MAK Technologies it was nice to know that I would still be working with same people in my new role at MultiGen-Paradigm. And it will also be nice to see my past customers and contacts as well. As most are aware there have been quite a few changes over the past two years. But I hope to bring some fresh ideas to helping our resellers be more successful. I feel with the combination of Multigen-Paradigm bundled with the innovative Computer Associates, will allow us to provide leading edge technology for years to come.

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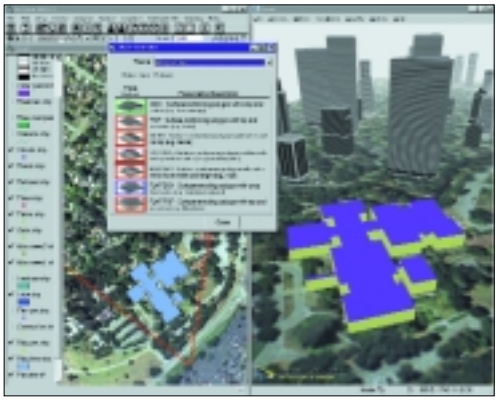
# MultiGen-Paradigm announces a new 3D GIS application–SiteBuilder 3D™



SiteBuilder 3D™ is a new application from MultiGen-Paradigm that will enable ArcView® GIS users to rapidly create realtime 3D scenes directly from their GIS data. SiteBuilder 3D will be delivered as a plugin, or extension to ESRI's ArcView GIS program.

The application will process elevation data, imagery and feature data into fully interactive high-fidelity scenes. Through a simple inter-face users will to identify the map layers they desire to visualize in realtime 3D. The 3D terrain can be textured with either the current map display in ArcView or with any image layer. SiteBuilder 3D will process all terrain textures using Vega's powerful new Virtual Texture process. Point features are projected using models accessed from SiteBuilder's Model Library containing a collection of fully textured OpenFlight models that represent buildings, landscape elements and signs. Line and polygon features are represented as flat or extruded features with either colors or textures for walls and tops. Once the scene is created a 3D viewing window provides choice for motion models as well as choosing eye points and environmental effects.

> "THIS IS A VERY EXCITING NEW PRODUCT FOR MULTIGEN-PARADIGM. OUR REALTIME 3D VISUALIZATION EXPERTISE DELIVERED THROUGH ARCVIEW GIS, THE LEADING DESKTOP GIS SOFTWARE PACKAGE, WILL NOT ONLY TAKE GIS VISUALIZATION TO A NEW LEVEL, BUT OFFER A POWERFUL NEW FRONT-END TOOL FOR EXISTING CUSTOMERS FOR DATABASE PRODUCTION."
>
> *Jon Zucker*
> *Project Manager*

In addition, SiteBuilder 3D will contain an OpenFlight Scene Export feature that will export any SiteBuilder Scene directly for use with Vega or MultiGen Creator.

The product will be available through existing MultiGen-Paradigm Account Managers and Distributors as well as selected ArcView GIS resellers.
Please refer to MultiGen-Paradigm's website or www.sitebuilder3d.com for ongoing details.

# The Olympic Fever Continues!

MultiGen-Paradigm is pleased to announce that the Toronto 2008 Bid Committee has partnered with MultiGen-Paradigm to create a realtime model of the City of Toronto. Toronto is one of the finalist cities identified by the International Olympic Committee (IOC) to host the summer games in 2008. The other cities competing are: Paris, Beijing, Osaka and Istanbul.
The Olympic Bid committee has planned to use the model during various presentations to the IOC, International and domestic press and other olympic officials worldwide. The Design Exchange, a non-profit group in Toronto, is currently building this model using MultiGen Creator and Vega.

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For more information on Toronto's quest for the 2008 games, please refer to: www.to-2008.com

# Analysis of Spatial Disorientation Mishaps in the US Navy

By Braden McGrath, Ph.D.
Naval Aerospace Medical Research Laboratory

Spatial disorientation and the subsequent loss of situation awareness account for a significant percentage of mishaps in aviation. Spatial disorientation occurs when the pilot has an incorrect perception of the attitude, altitude, or motion of one's own aircraft relative to the earth or other significant objects. The estimated annual material cost of spatial disorientation mishaps for military air forces, commercial aviation, and general aviation is in the billions of dollars (Gillingham, 1992). An example of the devastating effects of spatial disorientation is illustrated by the following mishap (Figure 1). In January 1996, shortly after take off, a US Navy F-14 Tomcat crashed into a residential suburb destroying several homes. The two aircrew and three people on the ground were killed instantly.

After becoming airborne, the F-14 accelerated and climbed at a steep angle into an overcast cloud layer. Shortly afterwards, the F-14 was observed descending below the cloud layer in a steep nose-down attitude. It then transitioned to a nose-up, slight left wing down attitude before impact with the ground. While the exact cause of the mis-hap and what occurred in the cockpit will never be known, the mishap board identified spatial disorientation and cockpit distraction as causal factors in the mishap.

During the critical approximately 10 sec of flight from when the pilot started the maneuver to level the aircraft at 5000 ft to the point at which the aircraft was unrecoverable just before exiting the clouds, the pilot had:

- *No outside visual cues.*
- *A resultant gravitational force vector that likely caused a misperception of pitch attitude (Figure 1, frame 3).*
- *Cockpit distractions that likely included conversations with the radar intercept officer regarding correct altitude to level off, and possibly warning lights triggered by the inverted nature of the G-forces (-Gz).*

The presumed momentary distraction leading to spatial disorientation resulted in the tragic loss of five lives and a financial cost of millions of dollars.

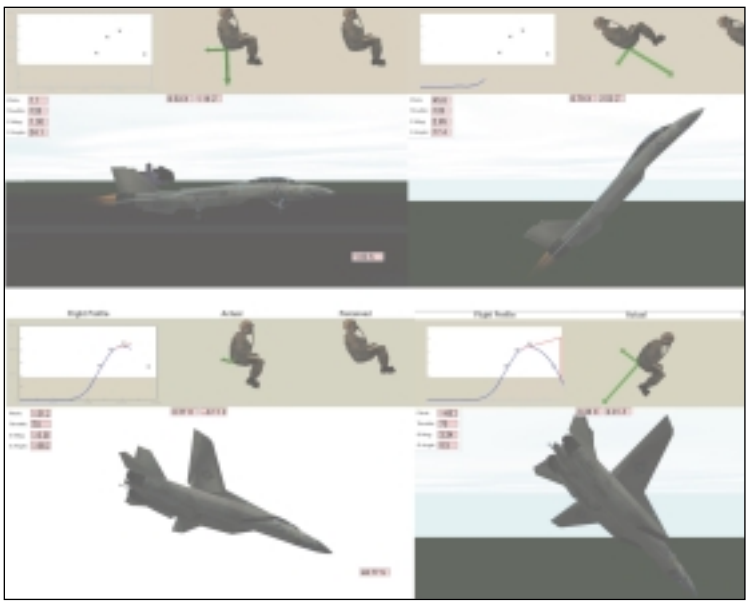

Figure 1. F-14 mishap time sequence.

To support US Navy mishap boards in their investigations, to provide insight into the problem of spatial disorientation in naval aviation, and to train aviators to avoid spatial disorientation mishaps, researchers at the Naval Aerospace Medical Research Laboratory use Vega™ (MultiGen-Paradigm) as an important tool in the development of three-dimensional computer simulations of spatial disorientation mishaps.

To develop the simulations, data from flight data recorders, eye witness accounts, and video tapes are reduced using MatLab™ (The MathWorks, Inc.) and then imported into Vega. Aircraft models and databases are created in MultiGen Creator™ (MultiGen-Paradigm) and also imported into Vega.

The Vega mishap simulation includes models of the actual aircraft and flight data, actual pilot position, and estimated perceived pilot position. These simulations provide an intuitive tool that permits visualization of a complex problem. Videos produced with the Vega simulation have been telecast on CNN, ABC News, and The Discovery Channel.

For further information, please contact Braden McGrath at (850) 452-4441 or brad@namrl.navy.mil.

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# CounterSim

## CounterSim

By DT Media Ltd.

DT Media Ltd (www.dtmedia.co.uk) is based in Stoke Gabriel, South Devon and uses MultiGen-Paradigm's Vega, MultiGen Creator and Vega Special Effects to create realtime simulation tools, either for use as stand-alone products or embedded in other training modules. In early 2000 DT Media signed a 5-year Co-operation Agreement with Chemring Countermeasures Ltd, the leading supplier of expendable decoys to the British Armed Forces and other military forces worldwide.

Countermeasures design is constantly evolving to meet the challenges posed by new threat systems. To maintain the effectiveness of its decoys, Chemring Countermeasures has developed a number of computer models to predict countermeasure effectiveness against existing and future Radar and Infrared-guided anti-ship missiles. The computer models take into account such factors as target size, missile tracking characteristics, the signature of the decoy being used and other parameters that determine if the decoy would provide adequate protection for the target ship.

The Chemring Countermeasures computer model produces a wealth of data in tabular form for each missile engagement. This data provides development engineers with the information they require to optimize the design of their countermeasures. However, Chemring recognized that the data could also provide valuable information for users of their decoys to help them understand how to employ their decoys more effectively.
DT Media were tasked to create a graphical interface called "CounterSim", to help users to visualize what the mass of data means in terms of decoy effectiveness. MultiGen Creator was used to build 3D models of typical ship targets; to provide a realistic model of the decoy pattern; and for the various types of anti-ship missiles that might be encountered. Vega Special Effects were used to emphasize the missile flight path and to show smoke from the ship's funnel to provide an indication of relative wind, whilst Vega was used to provide the realtime simulation environment.

In a typical run the target and missile types are automatically selected to represent those used in the Chemring Countermeasures computer model. If either type is not found in CounterSim's 3D model database, the user can select a similar 3D model from a drop-down menu. When a new model is added to the database, CounterSim automatically adds it to the drop-down menu. Ship models are readily available from DT Media's Insight recognition training system.

During each attack run the Chemring software calculates the effect of the countermeasures that have been deployed. The data is passed to CounterSim, which displays the accurate position and track of the ship; the position and movement of the decoy pattern; and missile flight path. During the run the user can pause CounterSim, run the simulation at reduced speed, and view the animation from various points, including the view from the missile seeker, the decoy pattern or the target ship.

Using the MultiGen-Paradigm development tools enabled DT Media to create CounterSim within the tight timescales required by Chemring Countermeasures. The ease with which different targets and anti-ship missiles can be selected allows the program to be used by any Navy. Future development of CounterSim will be simplified thanks to the user-friendly 3D simulation power of Vega and its associated utilities.

By creating a graphical interface for an existing in-house development tool, DT Media has enabled Chemring Countermeasures to offer the first in a series of new customer support products that will ensure their customers get the best from the decoys they buy.

# MultiGen-Paradigm Software Helps Burn Patients "Play Through Pain"

Harborview Burn Center

With the help of simulation software from Multigen-Paradigm, psychologist Hunter Hoffman is giving a whole new meaning to the concept of "playing through pain."

Hoffman and his colleagues Dave Patterson and Gretchen Carrougher at the Harborview Burn Center in Seattle, WA are using a virtual reality system to lessen the extreme pain that burn victims experience while undergoing burn treatment and rehabilitation. That pain is so severe that burn patients often resist the daily treatments that are needed to fully restore function to the burned parts of their bodies.

That's where the ingenious use of virtual reality comes in. It turns out that our experience of pain is deeply affected by how much attention we pay to it. Signals coming in from the nervous system to the brain can be interpreted as more painful or less painful, depending on what the patient is thinking about, and where their attention is focused. More distraction means less pain.

Therefore, Hoffman and clinical psychologist David Patterson decided to test the attention-getting power of putting patients into virtual reality during treatment. So far, two virtual worlds have been created, SpiderWorld and SnowWorld.

In "SpiderWorld", made with software from Division LTD, patients touch a furry toy spider which is electronically cued to a "virtual" spider image.

As the patient touches the virtual spider with their cyberhand, their real hand touches the furry toy spider in the real world. The brain unifies the sensory input from sight and touch into a single experience, giving the patient the odd sensation that they are physically touching a virtual tarantula.

The pain relief results were stunning. In a series of carefully controlled studies, the burn center team found that using virtual reality dramatically reduced their patients' awareness and experience of pain.

Using a pain index which ranges from 100 (most experience of pain) to 1 (least experience of pain), one group of patients went from a 60 pain index to a 14.

A burn patient, wearing his VR helmet, flies through "Snow World" during treatment. In the photo background, some of the images used to create the virtual reality environment.

# MultiGen-Paradigm Software Helps Burn Patients "Play Through Pain" *(continued)*

That kind of result has huge implications, and not just in treating burn patients. David Patterson describes the potential this way:

> *"Burn wounds are widely considered to be among the most painful injuries a person can endure. So, techniques that prove effective for treating burn pain will likely prove effective for dental pain, pain from brief painful cancer procedures, situations where the patient needs to be conscious, or where the medical procedure is too frequent to use general anesthesia. These preliminary results support the notion that VR might prove invaluable for pain control."*

With a recent gift from the Paul Allen Foundation for Medical Research, Hoffman, Patterson, and their team are already developing the next generation of VR pain-fighting environments.

Since a burn treatment can last 30 to 45 minutes, first on their list is the creation of a longer running VR session so that patients can do VR throughout a treatment.

Using MultiGen-Paradigm's Vega software, and with help from technical support at MultiGen-Paradigm, Hoffman has created an experience of flying a virtual fighter jet through an icy 3-D canyon, including shooting virtual snowballs at snowmen and igloos.

"SnowWorld" includes head tracking (e.g., patients see the sky when they look up, a canyon wall when they look left, etc), 3-D sound effects, texture-mapped icy canyon walls, an animated river with a waterfall, and animated explosions when their snowballs hit a target.

Patients wear a virtual reality high resolution helmet with a 60 degrees diagonal field of view, which allows some peripheral vision of the virtual world. In addition, the helmet completely blocks their view of the real world.

In a controlled laboratory study using undergraduate volunteers, Hunter and colleagues manipulated the degree of "presence" in SnowWorld. One group experienced the full high tech version described above, which is designed to elicit a strong illusion of presence in the virtual world.

A second group experienced a "low tech" version of SnowWorld–with no head tracking, no sound effects, no animations, no texture maps, and no snowballs.

The study showed that the stronger the illusion of presence in the virtual environment, the more pain reduction. Hoffman says of the study:

> *"In our next systems, we are going to focus on increasing 'presence'–the level of patient attention–and realism. New virtual worlds, custom built to be attention-grabbing, could produce even larger reductions in pain, and for longer durations. So that is what we're going for."*

One technique for increasing "presence" is to allow patients to personalize their VR sessions by creating their own virtual events using MultiGen-Paradigm's MultiGen Creator and Vega software. Using a computer cart that is wheeled to their bed, and with some assistance from a staff member, each patient will have the opportunity to customize their virtual reality session with their own creations –a testimony to the MultiGen-Paradigm software's ease of use. Later, during painful wound care, they will experience the virtual world they helped create.

Another major project that Hoffman and Patterson envision is a VR setup that can withstand water. The most seriously burned patients are treated in "scrub tanks." Bringing virtual reality to them will involve the use of fiber optics to send images directly to the helmets so that there are no electrical cables in the tank. Funded by a grant from the International Association of Fire Fighters, the Burn Center is already at work on a prototype.

Talking about the important role that software plays in all this, Hunter says:

> *"Because the burn patients are often groggy from medication, we are completely dependent on good simulation software to enable the patients to build increasingly attention-grabbing VR systems. Vega and MultiGen Creator are great products to work with. For ex-ample, patients can make a virtual avatar start running along an invisible path, stop, look around, and change directions, just by clicking a couple of buttons on the graphic user interface in Vega. Next time the patient goes into VR, the avatar displays this new behavior they just 'programmed'."*

Thanks to some very "friendly" MultiGen-Paradigm software, the folks are Harborview are inventing a new world where play helps patients fight pain.

# Real-Time Urban Simulation with 3D-GIS

## CAD Center Corporation

Yutaka TAKASE
CAD Center Corporation

CAD Center Corporation, since its establishment in 1987, has been involved with an enormous number of visual simulations using CG (computer graphics) and VR (virtual reality) technologies. CAD Center is widely known as a pioneer of computerized visualization in Japan, and has worked on over 200 visualization projects. The company produces high-quality visualizations using latest CG realtime 3D and animation technologies for various fields including urban planning, landscape design, architecture, civil engineering, housing development , event promotion, historical restoration and entertainment.

Recently, as the capability of computers has increased, CAD Center has been able to use real-time 3D simulation using large amounts of GIS and Geospatial data. Today, Realtime 3D projects comprise nearly one-half of the Center's yearly production. CAD Center uses MultiGen Creator and Vega to deliver solutions in the areas of urban simulation, machinery visualization, transportation simulations (railroad and aviation), tourism and emergency response management.

A Real-time Simulation System for a New Town Development. The system provides the experience of visiting a new town containing new developments.

### Real-time Urban Simulation with 3D GIS

As the client's needs for real-time urban simulations grow, more realistic 3D city models are required. At the same time, more productive methods for making 3D city models become necessary. Therefore, CAD Center Corporation has been involved in developing the methodology and software for the

Emergency Response Management System. The system provides real-time information and communication tools for quick and best-suited decision-making for fire response analysis.

# Real-Time Urban Simulation with 3D-GIS *(continued)*

Virtual Kyoto

automatic or semi-automatic generation of 3D city models.

Accurate 3D city models of large areas can serve as the infrastructure for 3D-GIS (geographic information system) applications. CAD Center believes that 3D GIS applications will soon be widely used for various purposes including business marketing, public services and tourism. CAD Center Corporation has recently developed 3D GIS prototypes for Virtual Kyoto and Virtual City Marunouchi.

## Virtual Kyoto

Virtual Kyoto is a demonstration application that was announced in April 2000, when Mitsubishi Corporation and CAD Center Corporation in demonstrated a a prototype of a realtime 3D city model generated from IKONOS satellite data with an accuracy of 1 meter. The area of Virtual Kyoto ranges approximately 11km by 6km. The terrain skin and high resolution texture was created by MultiGen-Paradigm. The buildings were extruded from a 2D digital map. Certain areas containing building facades are textured with digital photographs. This prototype runs on on high-end graphic workstations like SGI ONYX2 IR2 .

CAD Center Corporation's goal is to develop Virtual Kyoto into a tourism application system sometime next year.

## Virtual City Marunouchi

Virtual City Marunouchi is a prototype development of 3D-GIS which will be widely used in the near future. It provides both fly-through and walk-through capabilities around the Marunouchi area of Tokyo, one of the city centers of Tokyo.

The simulation application for Virtual City Marunouchi lets the user, display a particular building attribute data such as building names, switch from of flying to walking by clicking a highlighted street, select and place buildings from model libraries, and link buildings to their related internet homepages. Virtual City Marunouchi runs on WindowsNT workstations.

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Virtual City Marunouchi

Take Flight

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