

2006
MathWorks
Aerospace and Defense Conference



Virtual Environment Simulation Using
The Virtual Reality Toolbox

14-15 June 2006

Reston, Virginia

Presented by Eddie Mayhew
Syracuse Research Corporation

The Objective of this Presentation



To demonstrate the capabilities of the Virtual Reality Toolbox and the benefits therein.

Footnote: All screenshots in this presentation were generated by the Virtual Reality Toolbox from within the MATLAB environment.

Who would benefit using the Virtual Reality Toolbox?

Those involved with:

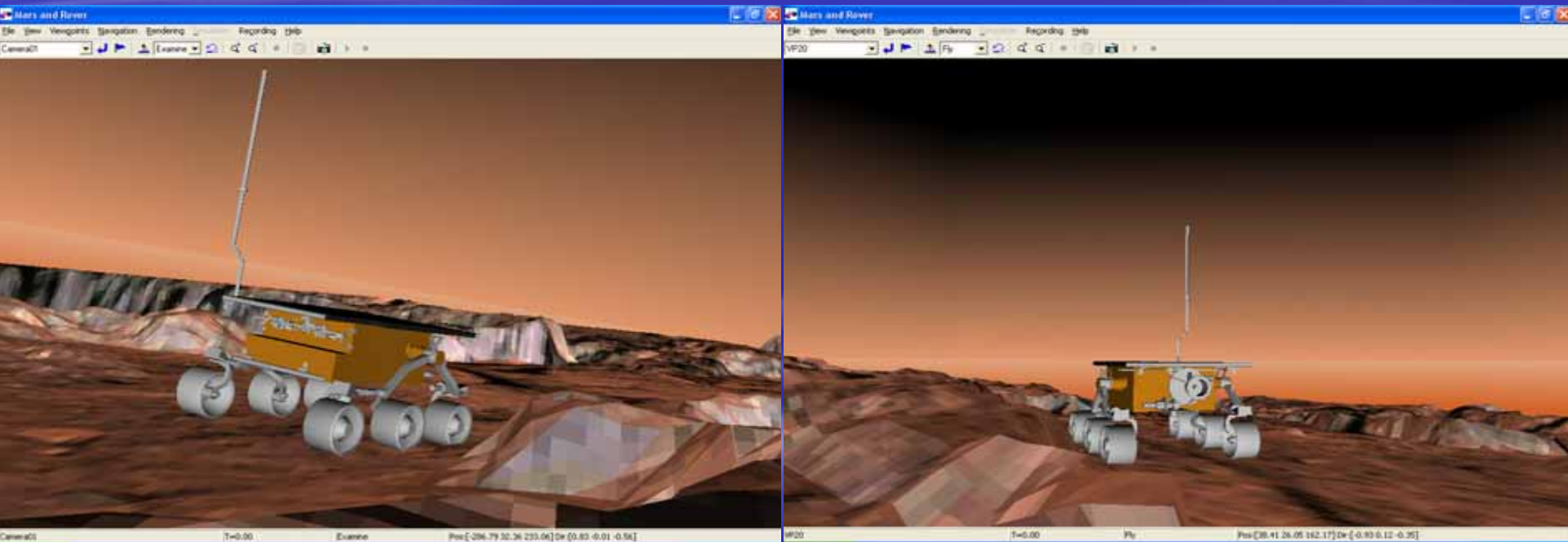
- Manned or Unmanned Flight Simulations
- Post-Flight Analysis
- Guidance/Navigation/Control Design Validation
- Intelligence/Surveillance/Reconnaissance Applications
- Air/Ground/Sea Radar Simulation
- Tracking Targets (Air/Ground/Sea)

The above is especially true if MATLAB is already being used.



Benefits Using the Virtual Reality Toolbox

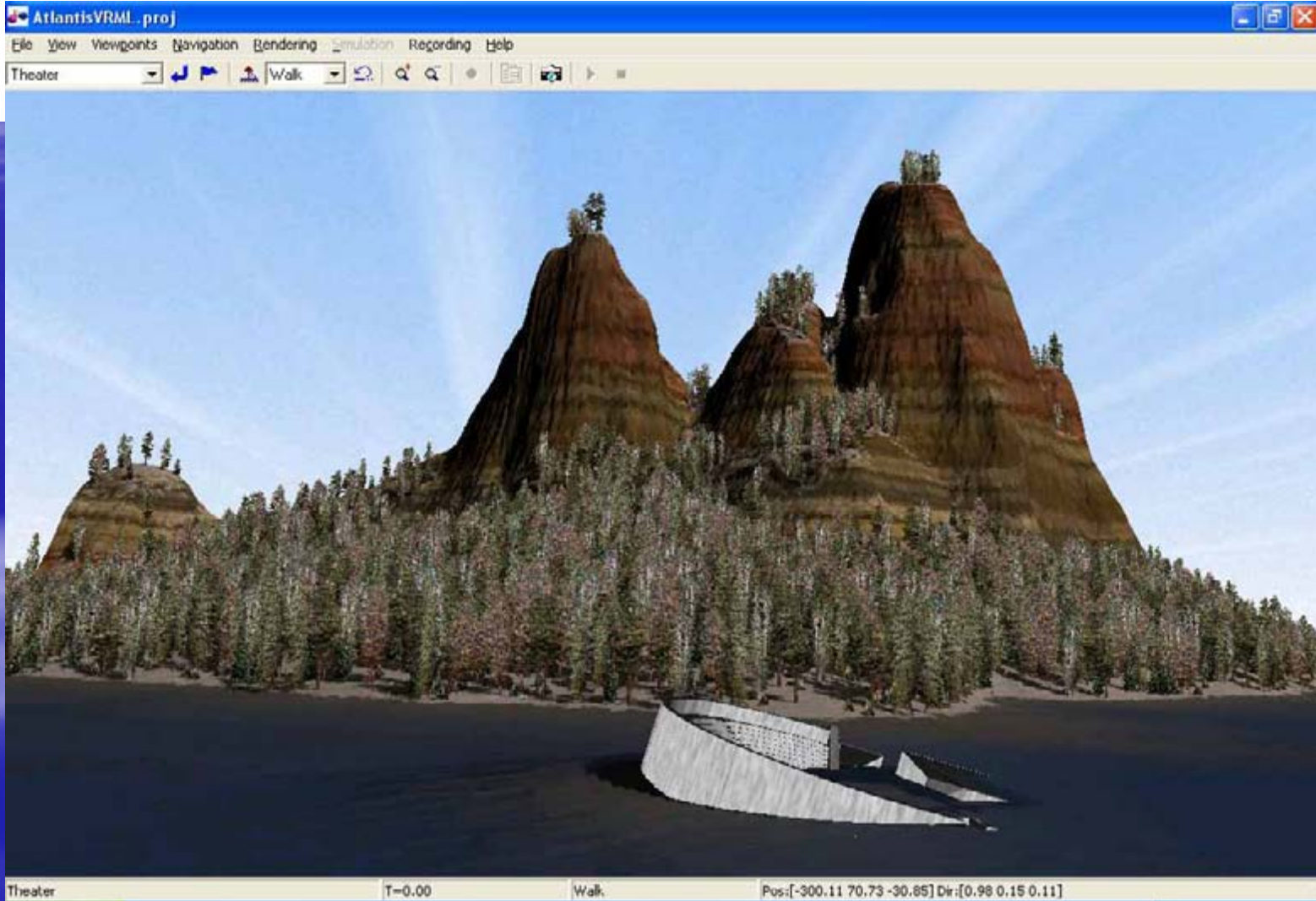
Fly, drive or sail virtually anywhere - on Earth, the Moon or Mars...



The Mars Rover on a “synthetic” Mars – Courtesy of Quadelta, Inc.

Benefits Using the Virtual Reality Toolbox

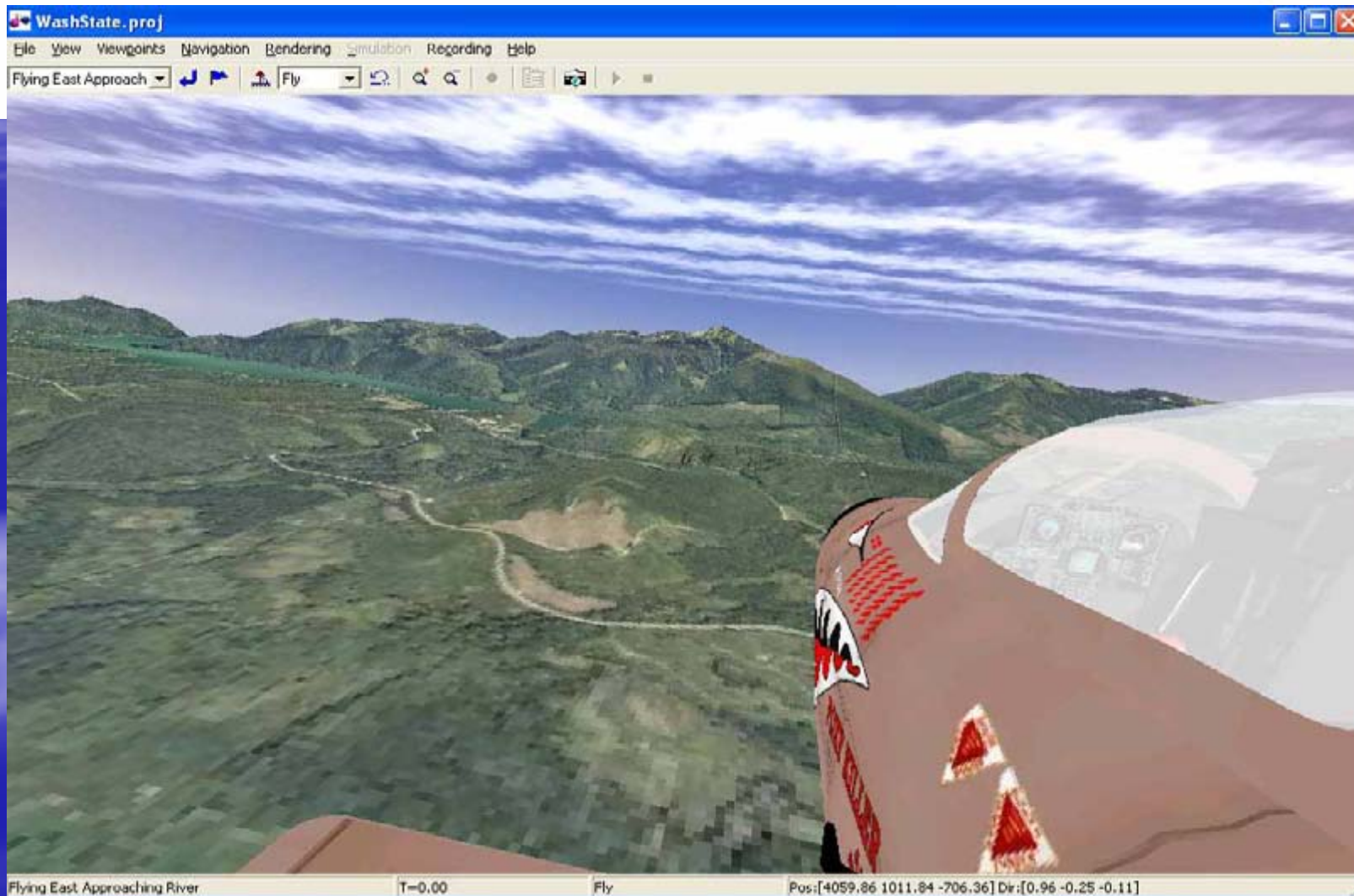
Display fictional scenes or....



Courtesy
of:
3DNature.com

Benefits Using the Virtual Reality Toolbox

... geographical ones.



A
Tornado
Cruising
Over
NW
Washington
State

Benefits Using the Virtual Reality Toolbox

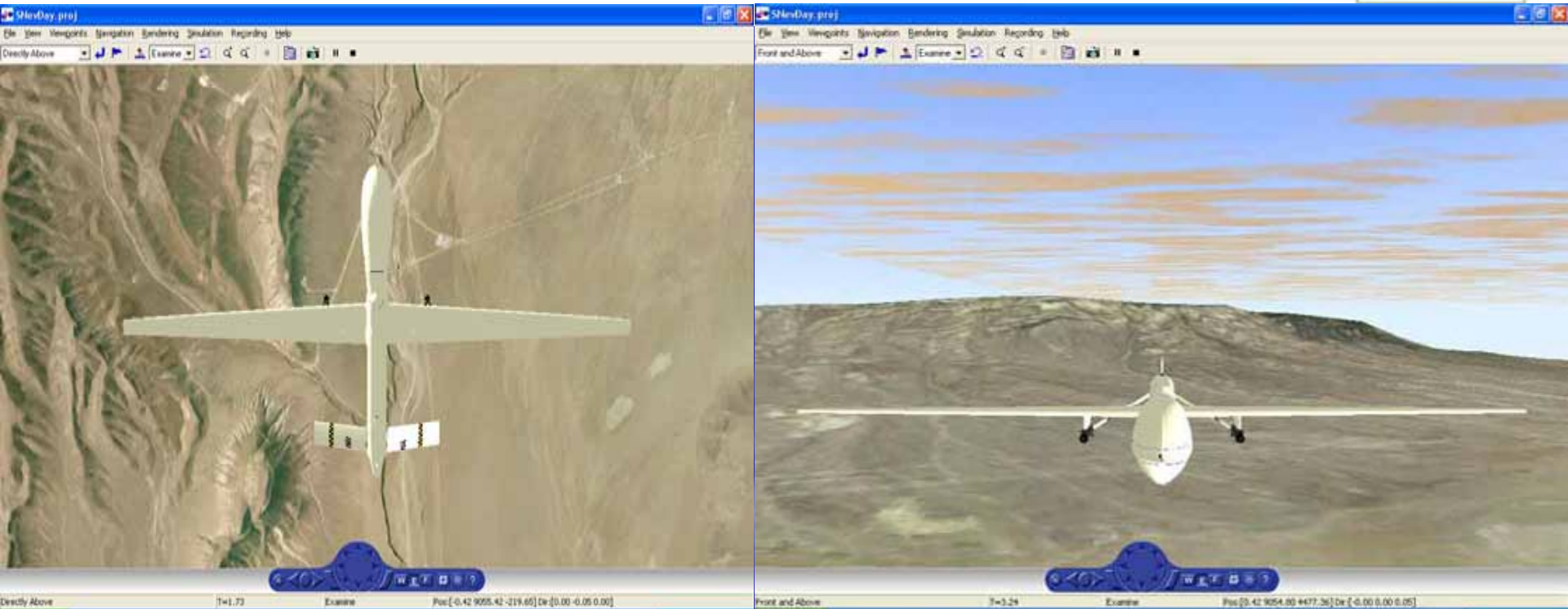
Scenes can be exoatmospheric...



Courtesy
Of
The
MathWorks
(less the
extra
moon)

Benefits Using the Virtual Reality Toolbox

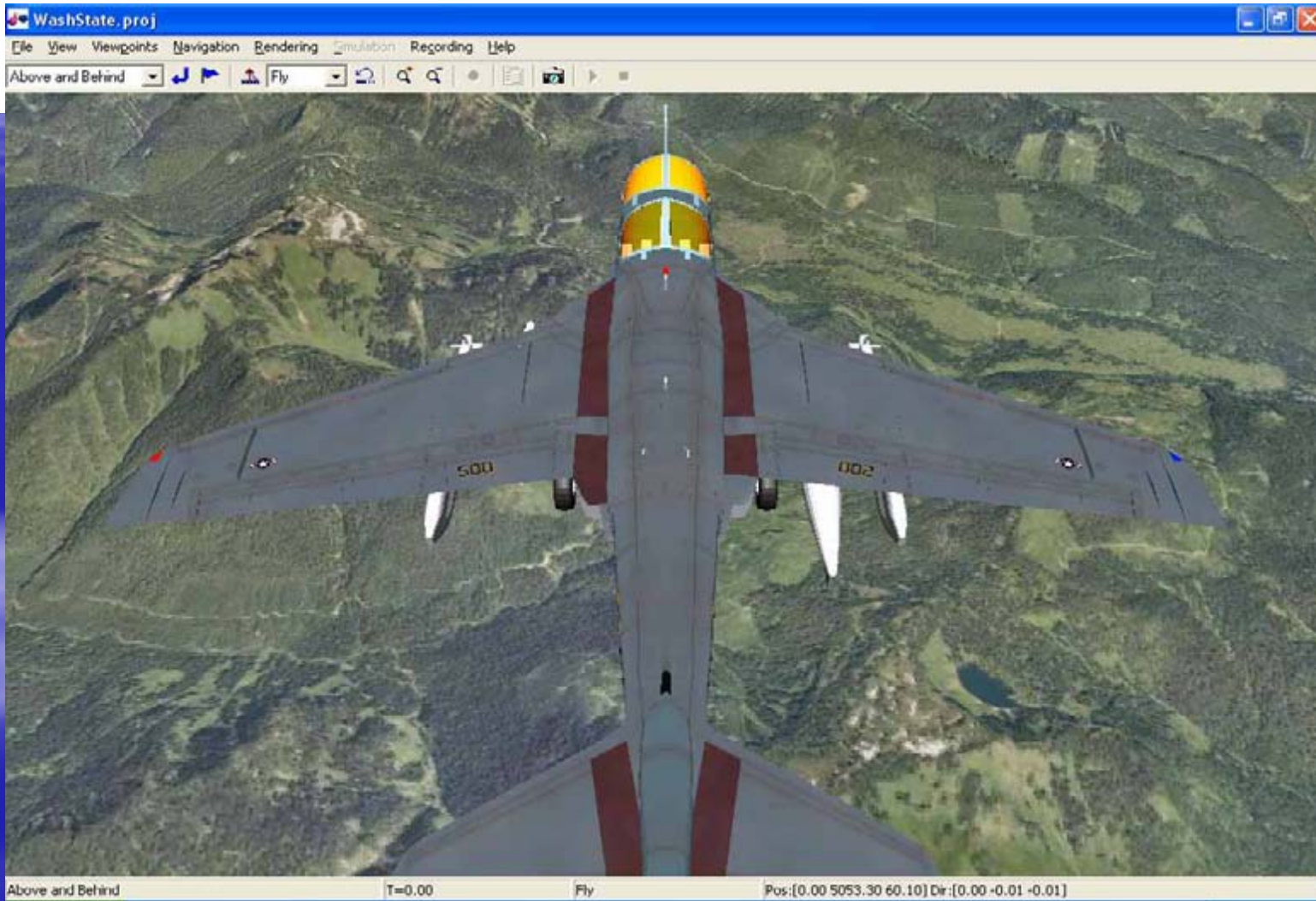
... or atmospheric.



A Predator Flying Over Southern Nevada

Benefits Using the Virtual Reality Toolbox

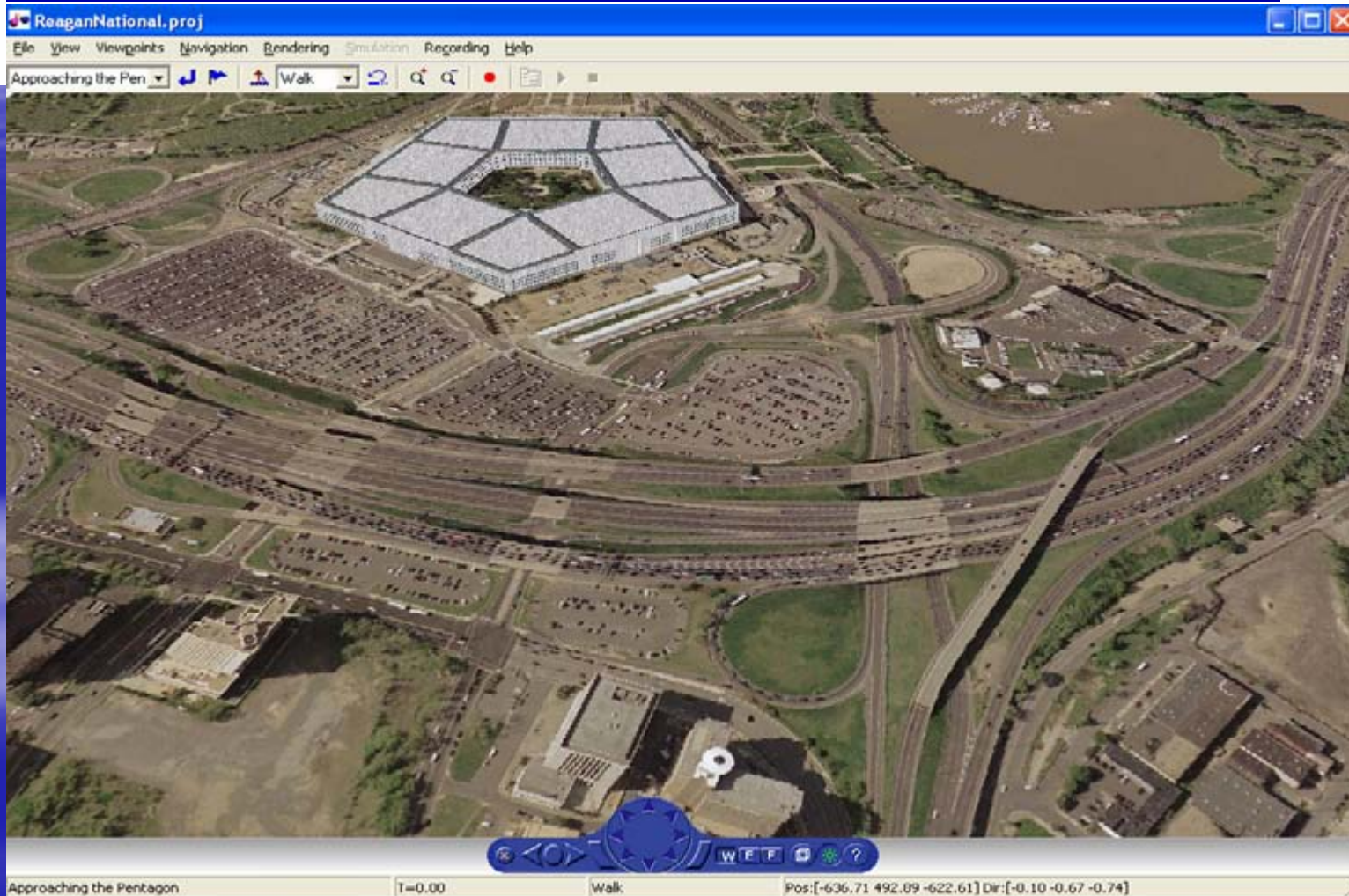
Update Terrain Images with Current Ones



An
EA-6B
“Prowling”
Over
NW
Washington
State

Benefits Using the Virtual Reality Toolbox

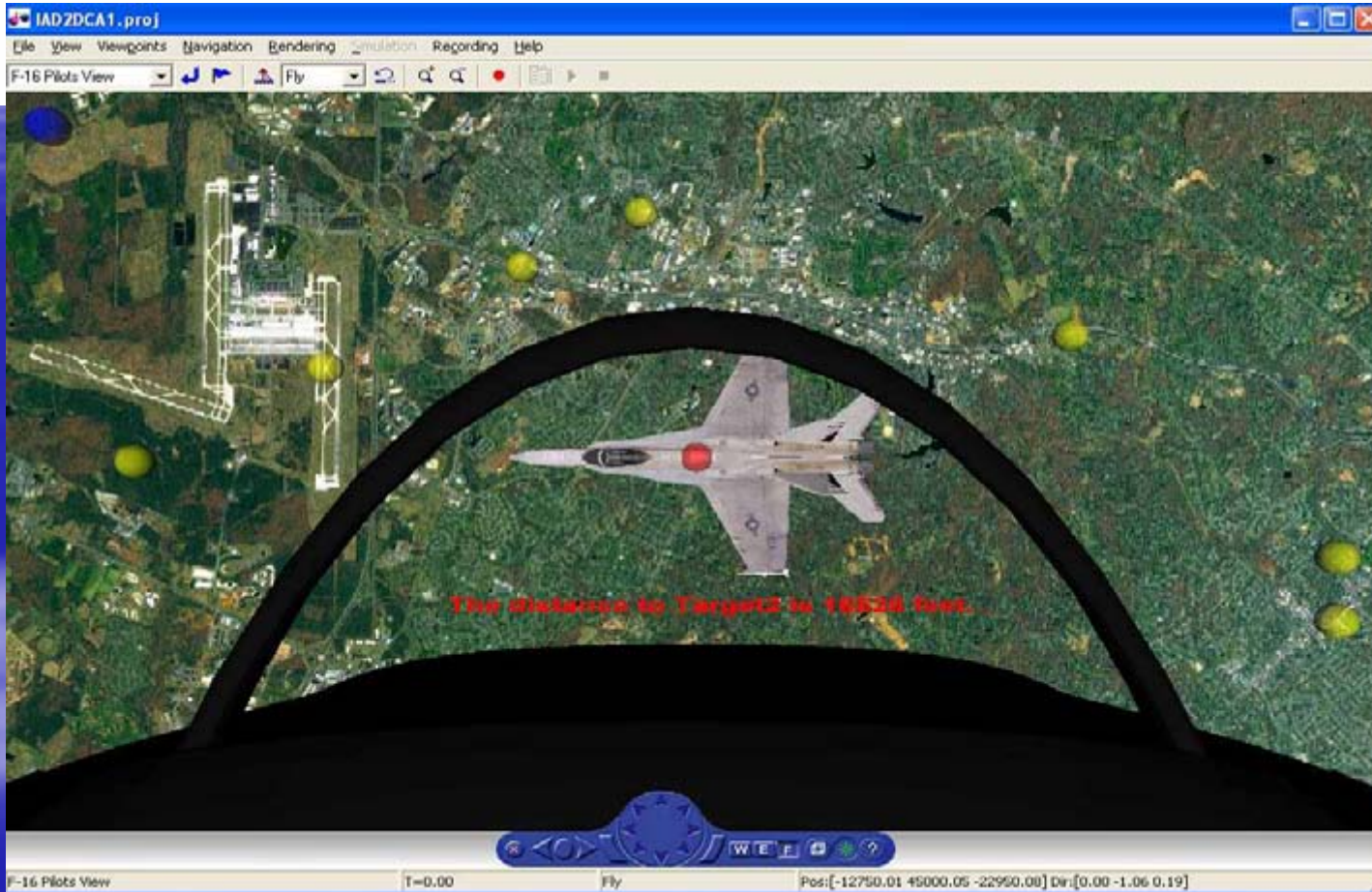
The capability to change the resolution of the texture map (aerial image).



Arlington,
Virginia
at
1-meter
resolution

Benefits Using the Virtual Reality Toolbox

Accentuate targets at great distances, using spheres, to verify radar analysis.

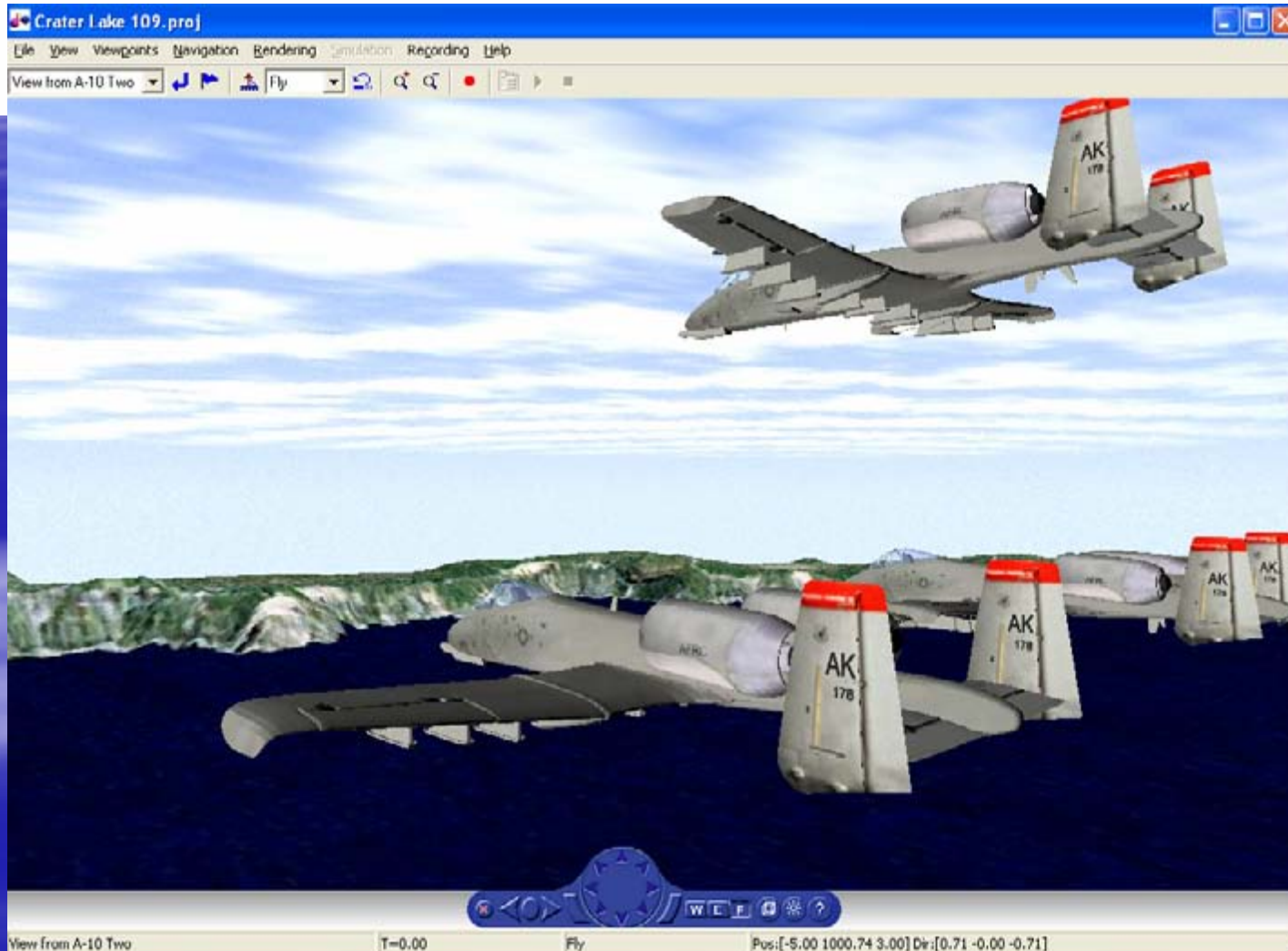


Courtesy
of:
George
Mason
University
Sensor
Management
System

Colors can be used to represent Identification Friend or Foe (IFF) results.

Benefits Using the Virtual Reality Toolbox

The 3D objects within the virtual world are as dynamic as MATLAB.

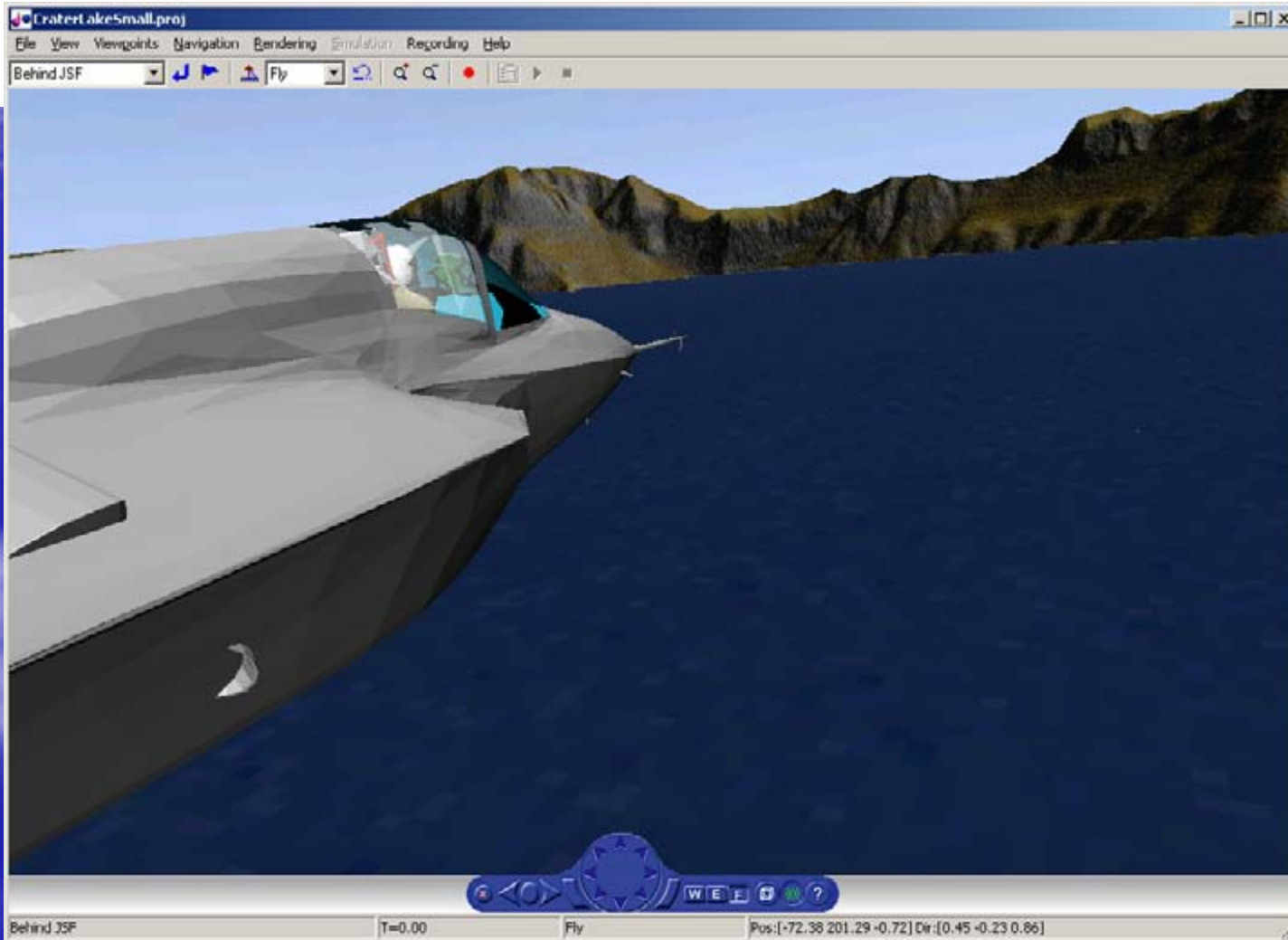


A-10s Flying Independently Over Crater Lake, Oregon

Courtesy of Quadelta, Inc.

Benefits Using the Virtual Reality Toolbox

An arbitrary number of "missions" can be flown over a given area.



Areas of 800 square miles have been used.

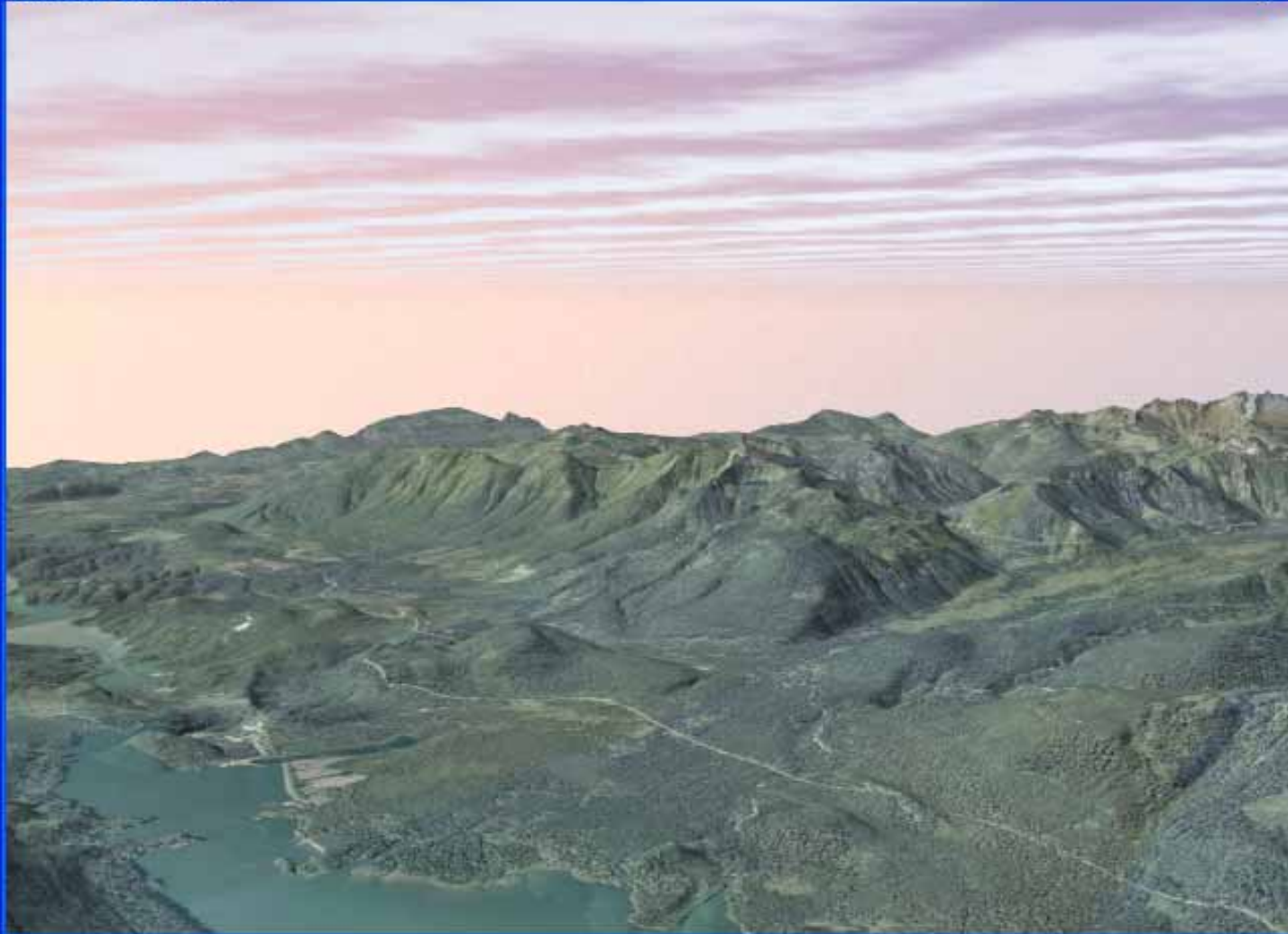
A JSF Flying Low Over Crater Lake, Oregon

Benefits Using the Virtual Reality Toolbox

The cost of building the scenes is affordable.



Rendering Complete



DEM data
and
aerial
image
purchased
from
MapMart.com

Benefits Using the Virtual Reality Toolbox

Easily build a MATLAB GUI as a front-end to the simulation using GUIDE...



... and still remain integral to the application without any complications.



Benefits Using the Virtual Reality Toolbox

Instrumentation can be embedded into the navigation panel any # of ways.



To the left
is the
cockpit of
a
Dassault
Rafale B.

Benefits Using the Virtual Reality Toolbox

Development time is reduced when compared to other languages.



Here a target is being painted by the ownship.

Courtesy of GMU – SMS

Benefits Using the Virtual Reality Toolbox

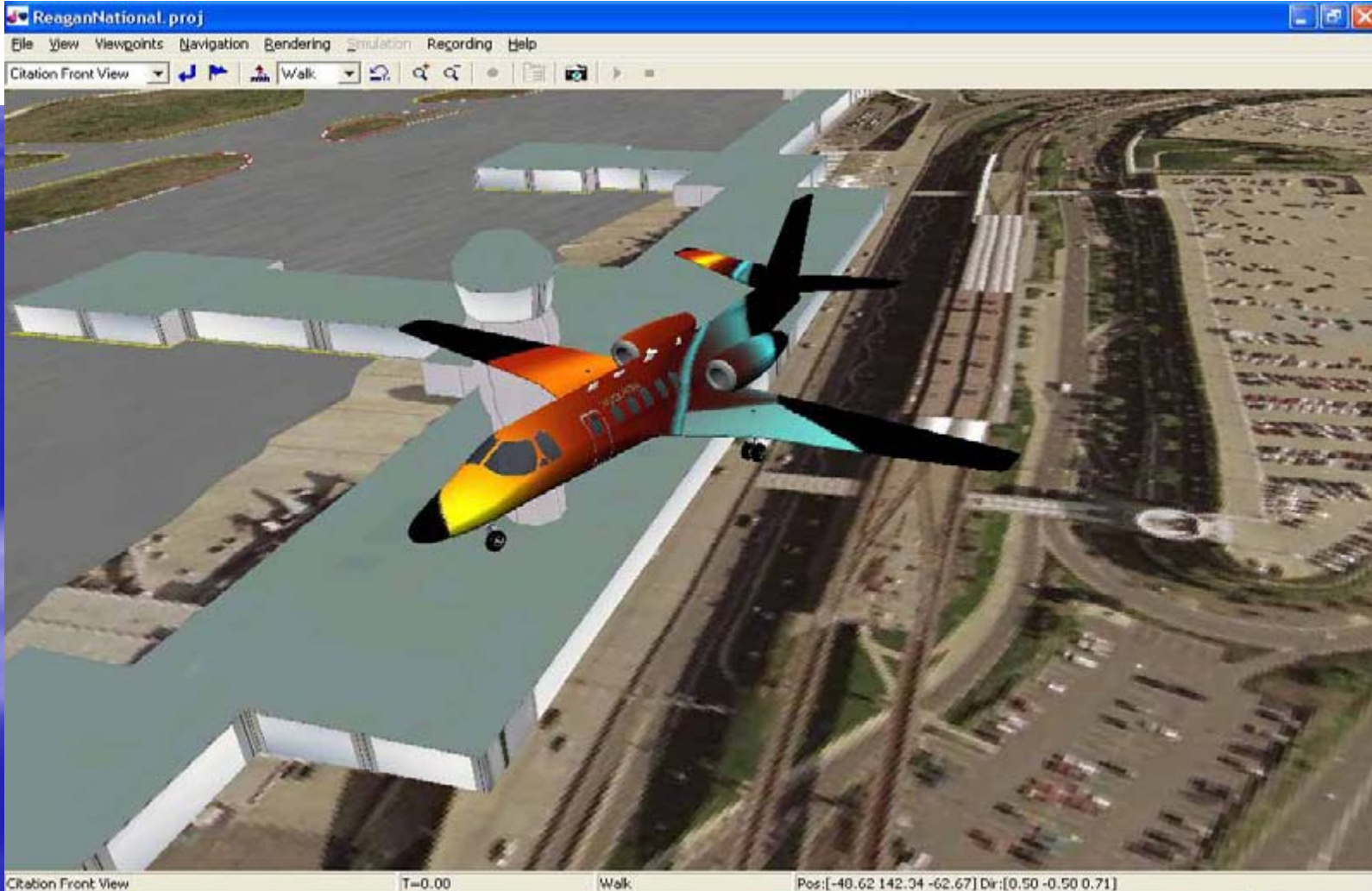
Add or remove virtually any 3D object to/from the scene at any time. To include:



An LCAC
on Crater
Lake,
Oregon.

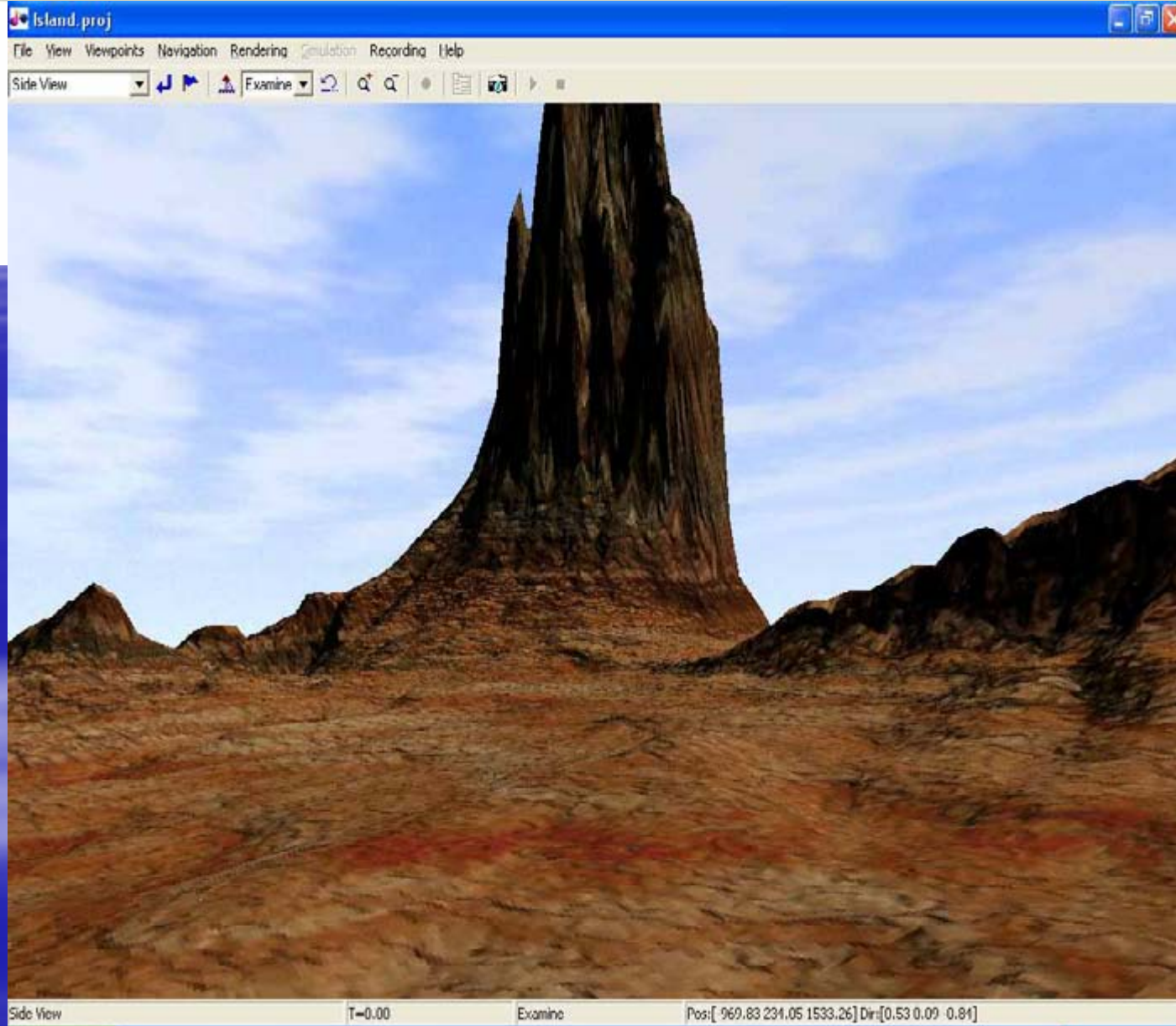
Courtesy
of
Quadelta,
Inc.

Airports, Citations, Runways



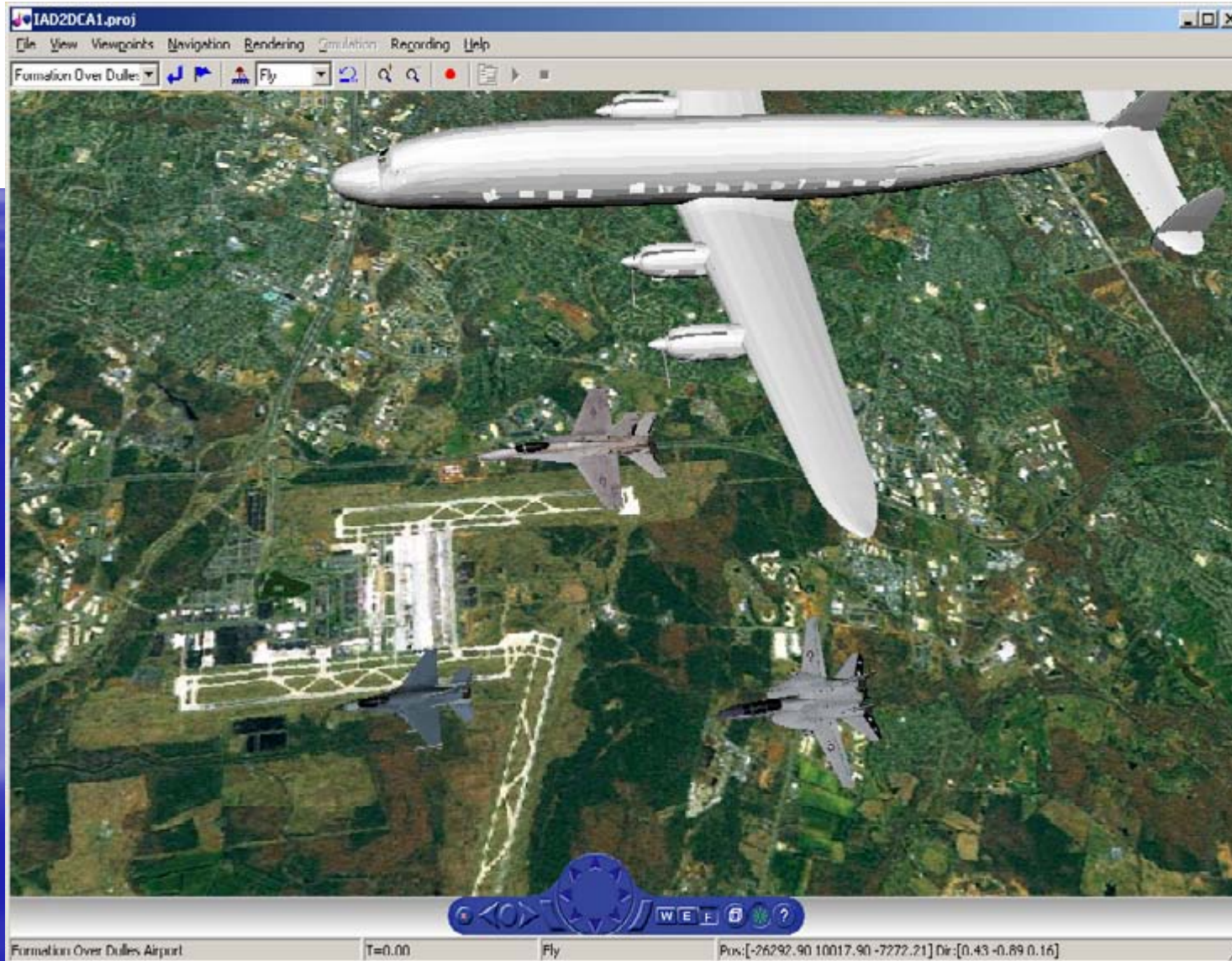
Courtesy
of:
The
MathWorks
Corporate
Cessna

Mountains, Rocks, Deserts



Terrain
Generated
by:
World
Construction
Set

F-14s, F-16s, F-18s, C-121s



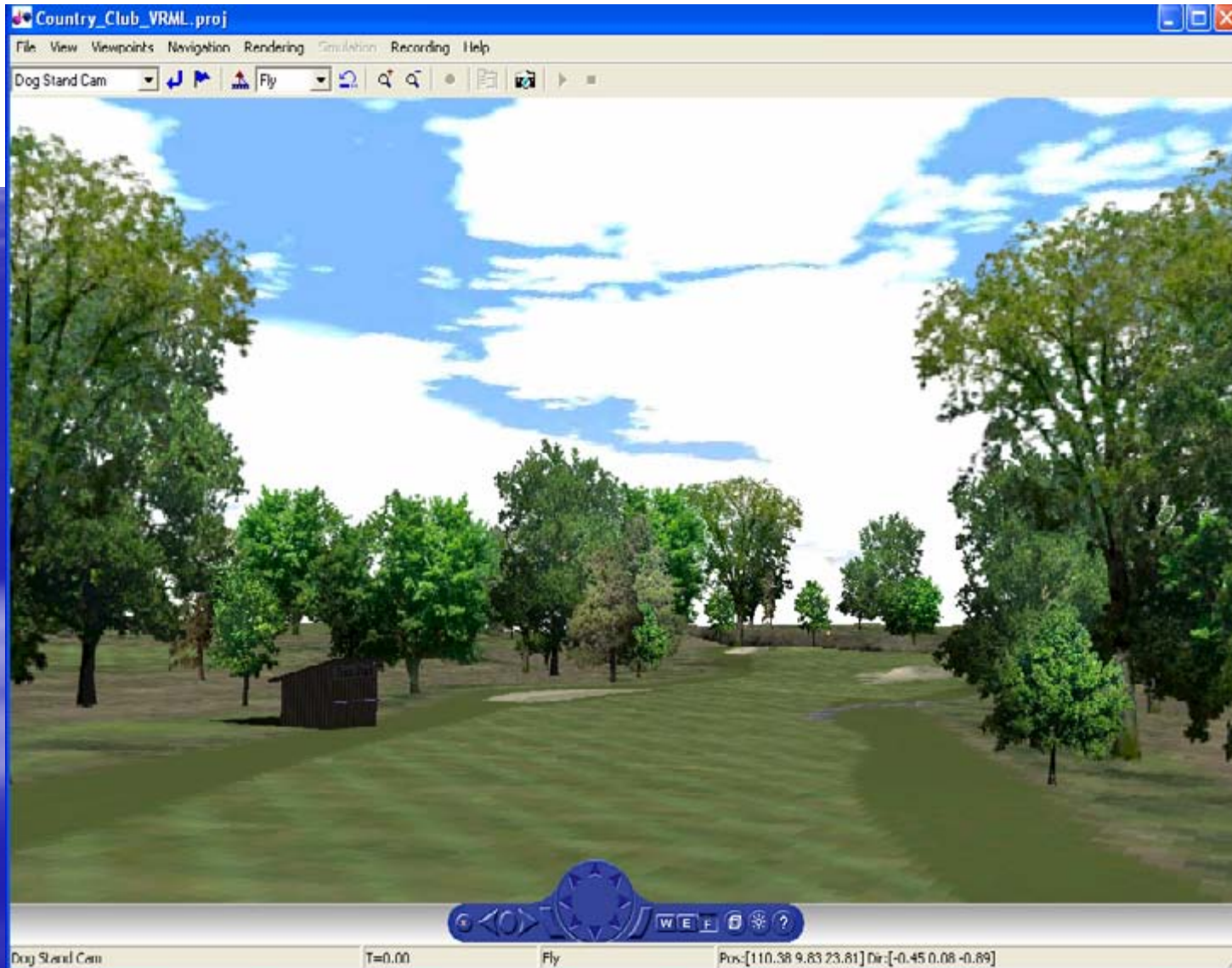
Courtesy
of:
George
Mason
University
(SMS)

Ground Vehicles, Radar, Beamforming



Courtesy
of:
Defense
Intelligence
Model
Simulation
Resource
Repository

Foliage, Clouds, Structures



Courtesy
of:

3DNature.com

Benefits Using the Virtual Reality Toolbox

You can edit the source code.



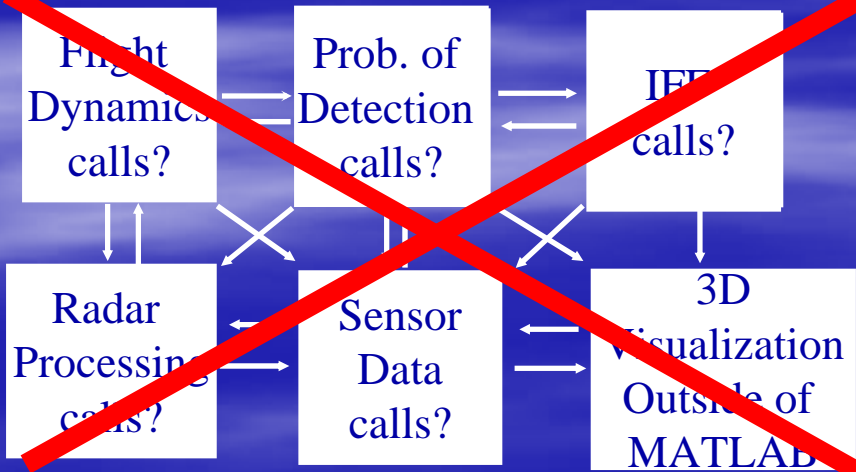
Make adjustments to the flight dynamics, waypoints generators, radars, sensors, weapons systems, whatever, ...
...immediately.

Benefits using the Virtual Reality Toolbox

Absolutely No Integration Concerns



A Stand-Alone
MATLAB
application integral
with its visualization



- No worries as to whether or not the 3rd party application will compile.
- Visualization has *instant* access to processed data
- No function calls outside of MATLAB application

Benefits Using the Virtual Reality Toolbox

Virtually Unlimited Distribution



Stand-alone
MATLAB
Application
with 3-D
Visualization

• • •

• • •

• • •

Stand-alone
MATLAB
Application
with 3-D
Visualization

$N = 1$

.....

$N = \text{A Gazillion}$



All possible using the following MathWorks products:

- MATLAB
- Virtual Reality Toolbox
- Image Processing Toolbox (terrain image enhancement and increased resolution)
- Mapping Toolbox
- MATLAB Compiler

Time limitations prevent much more of an explanation than this...

Special thanks goes to:



- The MathWorks Tech Support - especially the Virtual Reality Team. The best in the business.
- Dr. Ken Hintz of George Mason University's Sensor Management System.
- 3DNature for their support regarding the building of the terrains in this presentation.



5 Minutes for Q&A

Questions?

Contact Information



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