



Visualization Tool for Planetary Science Operations Planning

Trainee Seminar Session

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VEX VSOC 30-03-2011, ESAC





This is NOT just a nice faked picture of Venus



This is a UV image taken by VEX with the VMC instrument



How is this image taken?



Orbital insertion April 2006
Polar Orbit
24 hour period
66000 km apocenter
250-400 km pericenter

VISUALOPS

Venus Monitoring Camera
VIS, IR, UV filters
Atmospheric structure
Atmospheric dynamics





The Science Operations Planning process

VISUALOPS



- •Elaboration of PTR files
- Planners: "limb engineers" between pure scientists and pure engineers



How is this image taken?

The Science Operations Planning process

VISUALOPS







How is this image taken?

IS THIS THE BEST IMAGE TO TAKE?

- The geometry of the observations is of key importance
- Observations are characterized by positions and attitudes of the spacecraft in relation to the planet, sun, star positions...
- Different payloads pointing requirements not always compatible: decisions have to be made on which experiments take priority



VISLALOPS VENUSES

IS THIS THE **BEST** IMAGE TO TAKE?

SCIOPS teams do not always have access to a cheap, feasible and quick visualization tool that would improve and optimize the decision making on planning and the posterior data analysis.

MAPPS, main tool used for planning:

- Lack of 3D visualization
- Slow
- •Hard to work with orbit-by-orbit individual pointing

PTB, Project Test Bed (not being used by VSOC)
Hardly adaptable to user needs
Slow



IS THIS THE **BEST** IMAGE TO TAKE?

The goal of the project was to develop in six months a tool which would easily and quickly provide a tridimensional representation of a VEX VMC observation in order to be able to improve the pointings and optimize the spent time on their determination.

Five months later...

esa //sc/2005 Visualization Tool for Planetary Science Operations Planning









Starting point:

•Basic and clever program developed by Miguel Almeida • 262 code lines in IDL split in a procedure and a function •Took 40 seconds to run on a **IGbVirtual Machine** •2D projected image calculating pixel by pixel value









• **Second Second Second**

Has proven to be ideal combining IDL capabilities for:
Integrated Graphical Objects to represent the geometry
Widget programming to easily construct a Graphical User Interface

•SPICE, an ancillary information system for Planetary Science focused on the Solar System developed by NAIF at JPL (NASA)

Intensive usage of ICY (IDL SPICE implementation) functions with VEX SPICE Kernels
Ancyllary data provided and orbital mechanics calculations performed by SPICE





Structure:

· eesa

Modular and Object Oriented design strategy

• Current version consists on 100 files aprox with an average of 100 lines per file (10000 lines)









INITIALIZATION



Time: UTC or Pericenter
Pointing: Nadir, Track, Planet
Tracking, Intertial, Kernel
based

Attitude: Power Optimized, Push Broom, Kernel Based
Instrument: VMC (UV,VIS & IR), VIRTIS, SPICAV
Spacecraft Pitch and Yaw
Surface Point Latitude and Longitude
Celestial Sphere Right Ascension and Declination •VISUALIZATION of VEX
•VISUALIZATION of Orbit
•VISUALIZATION of FoV
•VISUALIZATION of Venus
•VISUALIZATION of ...



•THERMAL PROFILES







Navigation bar



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Distance to target [km]		Distance to target [km]			
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Pointing and Picked Parameters frame		Pointing Parameters		
		Sub-Observer Point Latitude [deg]	-53.036269	
		Sub-Observer Point Longitude [deg]	-92.821786	
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Distance to target [km]				
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Orbital Elements frame











Thermal Profiles Tab







Performance:

Takes 2.6 seconds to run on a IGb Virtual Machine
The tool has to be initialized only once in IDL afterwards is GUI-autonomous
The tool will be able to be run independently from a licensed IDL in the near future

The tool has been validated using VEX previous observations

Let's have a look at it! (if Murphy allows us to)







Pericenter Time: 1333T-02:34:59 Pointing: Attitude: Instrument:

Tracking (Lat = -46.55, Lon = 288.239) **Power Optimized** VMC-UV







- •Ready to be used at the beginning of MTP066 (later January)
- Validated in mid-January
- •Firstly used at the end of MTP066 (end of February)
- •Extensively used by VMC in MTP067 (March)





VisualOPS is...

- Reducing the amount of time spent on VMC PTRs elaboration
- Increasing the confidence on the decision making process
- Ready to give as output any required parameter
 Reaching its initial objectives:

A QUICK PLANETARY GEOMETRY VISUALIZATION TOOL TO OPTIMIZE AND SIMPLIFY THE PLANNING PROCESS





VisualOPS will...

 $\bullet \bullet \bullet$

Be a standing alone application
Prove its modularity being applied to visualization for other missions: BepiColombo, MEX...
Implement new features for interactive Thermal constraints to optimize planning process
Implement initialization files (metakernels) and output files with saved states

 Implement anything that my good supervisor asks me to

(if there is time)





Thanks for your attention!

GOOD MOMENT TO MAKE QUESTIONS

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