



**agi 2005**  
**USERS' CONFERENCE**  
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**Real-Time Data Feed with LabVIEW**  
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ATK Elkton – ATK Launch Vehicle Team

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### Project Description



- Flight Computer and IMU flown as experiment on NASA sounding rocket
- Navigation data and resultant steering commands recorded via telemetry
- Position data verified versus Radar in post-flight analysis



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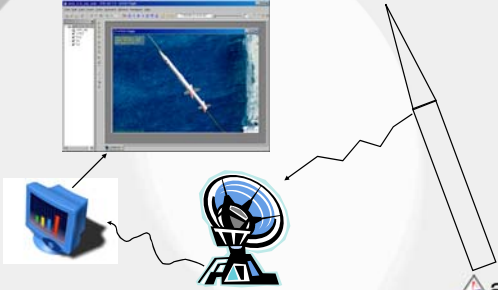

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### Nav Data to Real-Time Display



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### Project Achievements with STK

- Real-time visualization of launch vehicle flight path and attitude with data from live telemetry feed
- “Quick-look” postflight analysis – comparison with Radar (position) and on-board video (attitude) for navigation accuracy assessment
- Extensive postlaunch data analysis, including error model visualization



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### Graphic = 1k Words



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### STK/Connect and LabVIEW

- LabVIEW is a graphical programming environment that has very powerful numeric array and string handling capabilities, and easy numeric to string conversion
- Building user interface is very simple
- Basic TCP functions built in – Open, Write, Read, Close Connection
- Additional functions added to create Connect commands from raw telemetry data



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### STK/Connect Commands Used

- Scenario configuration:
  - SetUnits; SetEpoch; SetTimePeriod
- Animation setup and control
  - Animate SetValues; SetTime; Start Forward
- Vehicle attitude initialization example:
  - SetAttitude \*/LaunchVehicle/L1 Profile Fixed Euler 91.1 80.9 0.0 323 "Facility/WFF\_Pad\_1 Body"
- Launch Vehicle live data:
  - SetPosition; AddAttitude (alternating)



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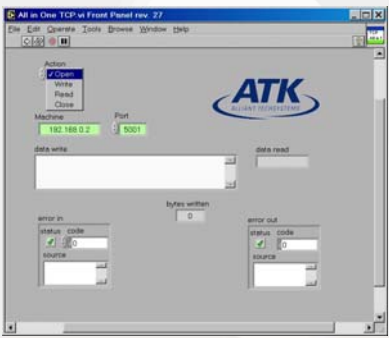
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### LabVIEW TCP Easy As ABC



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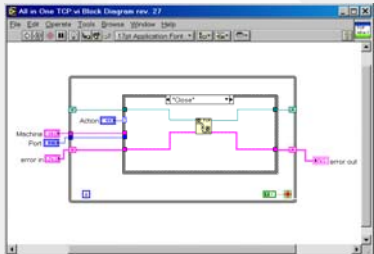
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### Behind the Scenes



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### Connect Command Generation

| Index | length | new subentry | Pre & old subentry | old subentry |
|-------|--------|--------------|--------------------|--------------|
| 0     | 43 77  |              | 0 40000E+6         | 0 130914     |
| 1     | 11     |              | 3 73070E+6         | -0 294401    |
| 2     | 11     |              | 3 57910E+6         | 0 3501       |
| 3     | 11     |              | 2 71 03            | 0 960904     |
| 4     | 43 77  |              | 2 4 01             |              |
| 5     | 43 77  |              | 0 030045           |              |

SelfPosition and string  
SelfPosition "LaunchPhase1 Reference 766 020° 3436075 7 370205 4 387617 6 -071 0

Addressable and string  
Addressable "LaunchPhase1 Queue 766 020° 0 131 -0 294 0 300 0 96 7

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### STK and Post-Flight Analysis

- Attitude Analysis
  - “Quick-Look” comparison of on-board video with STK animation camera view using “STK/Connect” data
  - Solar Aspect Angle comparison to NSROC(a) Solar Aspect Sensor
- IMU/Navigation Position Comparison to Radar
  - easy computation of position delta between Navigation solution and Radar Data via Access reports
  - Graphical visualization of position uncertainty at specified times

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### Immediate Post-Launch Views

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(On-board video reversed due to periscope mirror)

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### Earth Limb Views

(On-board video reversed due to periscope mirror)

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### Solar Reflection Views

(Sun Vector added to show source of reflection in onboard video)

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### Solar Aspect Angle Comparison

- STK with Vector Geometry tool made determination of Solar Aspect Angle easy!

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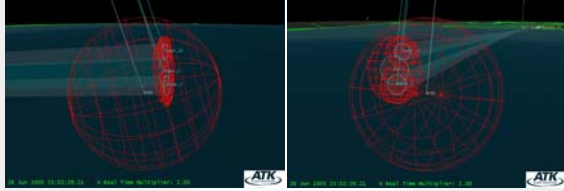
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### Uncertainty Visualization

- STK makes it easy to present compelling visualization of position measurement uncertainty from radar and on-board navigation data sources



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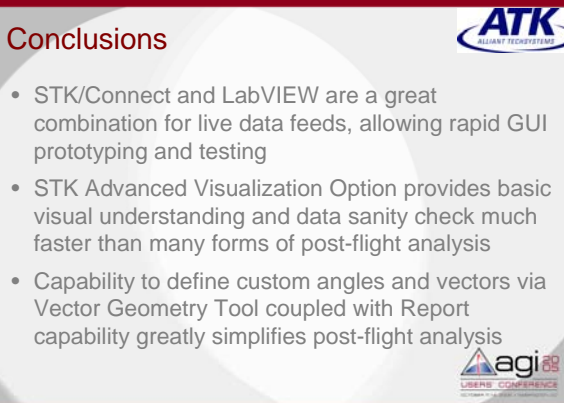
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### Conclusions

- STK/Connect and LabVIEW are a great combination for live data feeds, allowing rapid GUI prototyping and testing
- STK Advanced Visualization Option provides basic visual understanding and data sanity check much faster than many forms of post-flight analysis
- Capability to define custom angles and vectors via Vector Geometry Tool coupled with Report capability greatly simplifies post-flight analysis



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