Missile Flight Test Planning and Analysis with STK

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System Test & Evaluation Performance Analysis Lab (STEPAL)

- Supports GMD and MDA
  - Chartered in 2002 as a GMD asset
  - Mission: **Ensure test executability**
    - Issues found early reduce impacts on budget/schedule
    - All GBI intercept tests and selected other MDA flight tests
  - Success led to expanded role
    - Missile Defense System performance predictions
    - Operational support
    - Test execution support
    - Analysis of options and concepts
STK — A STEPAL enabler

- **Broad use in STEPAL**
- **Test planning**
  - When can I see it? Where? For how long? Sun a factor?
  - Where to put mobile assets?
  - What’s the aspect angle? Link margins good?
  - Give me pictures/animations
- **Test operations and post-event analysis**
  - When safe to launch?
  - Was flight nominal? Deviations?
  - Give me pictures/animations

“STEPAL uses STK the way I envisioned it would be used.”

Paul Graziani, 2008
Initially acquired for visualization

- **Enhances comprehension of complex dynamics**
- **Improves analysis execution**
  - Real-time sanity checking of work
  - Stimulates ideas for innovative analysis techniques
  - Enables capitalization on serendipity observations
- **Aids communication and decision-making**
  - Products are timely, correct and look good
  - “Much of STEPAL’s work went to the President, essentially unchanged.” - LTG Obering, Former Director MDA

Maximizes value STEPAL delivers to customer
Analysis capability realized a greater benefit

- **STK analysis content in most STEPAL products**
- **Key functionality examples**
  - Timing & geometric analyses (Access, Chains)
  - Asset location optimization (Coverage (2D & 3D))
  - Link analyses (Comm)
  - GPS navigation quality predictions (NTK, Components)
  - Graphics & animations (Snap Frame, Camera Control)

Keeps STEPAL prepared to serve customers
Test planning and optimization analysis

- From where should airborne sensor support test?

- Optimize competing requirements
  - Desired aspect angle
  - Maximum time at desired aspect
  - Maximize desired trajectory viewing
  - Avoid safety keep out regions

- Options limited by sensor constraints

- Similar analyses for land-based, airborne and surface test assets
  - Optics
  - Radar
  - Data links
Test execution support

- **When will GPS navigation accuracy permit safe launch?**
  - **Test day GPS constellation modeled**
    - Missile trajectory and attitude flown
    - Receiving antenna pattern modeled
    - Links analyzed over time per criteria
    - Collectively analyzed
    - Nav solution quality determined
    - IIP uncertainty determined
    - Go/NoGo recommendations issued

- **Used by range for launch window opening**

Inadequate GPS navigation solution closes launch window for safety reasons
Test execution and operational support

- How can debris hazards be minimized?

  - Debris risk and mitigation analysis
  - Population density map overlay on STK
  - Orbit or missile trajectory trace
  - Event timing or trajectory variables
    - Avoidance of dense population areas
    - Alter intercept geometry to reduce risks
  - Determine when and where to engage
COTS flexibility

- Customer requests change…always needed now
  - Don’t always match out-of-box STK capability
  - Insufficient time for traditional manual approach

- STK’s flexibility and adaptability is the answer

- Custom tools and utilities
  - Creation of multiple objects from LLA lists
  - Multi-function controls, reconfiguration, scenario tracking
  - Creation and editing of model articulation files
  - Post-processing STK and NTK output
    - Auto generation of Go/No-Go tables

STK expands STEPAL’s capability
Reliable technical backup

- AGI stands behind products/customers
- Virtual presence provides reliable technical backup
- AGI personnel responsive to calls for help
  - Challenging tasks require advanced techniques
  - Suggest work-arounds
  - Responsive to needed features
  - Access to company experts
  - Calls to Support answered by a person right away

AGI people help STEPAL be successful
STK helped STEPAL establish and grow support to MDA
- “New kid on block” in 2002
- Needed timely, correct and good-looking products
- Initially acquired for visualization…
- Allows STEPAL to aid communication and decisions

Analysis capability realized a greater benefit …
- Keeps STEPAL prepared to serve customers

Flexibility and technical support…
- Lets STEPAL quickly address new, challenging, unconventional tasks

STK is essential to the STEPAL mission
Questions?
STK – A business enhancement

- **STK support by SAIC (an AGI business partner)**
  - Developer of AGI Missile Modeling Tools

- **Support of missile defense customers**

- **STEPAL support**
  - Defined requirements for initial STK purchase
  - Trained STEPAL personnel
  - Provided on-site support since 2002
  - Provide in-house STK assistance and training

**STK expands business potential**
STK: A winning combination!