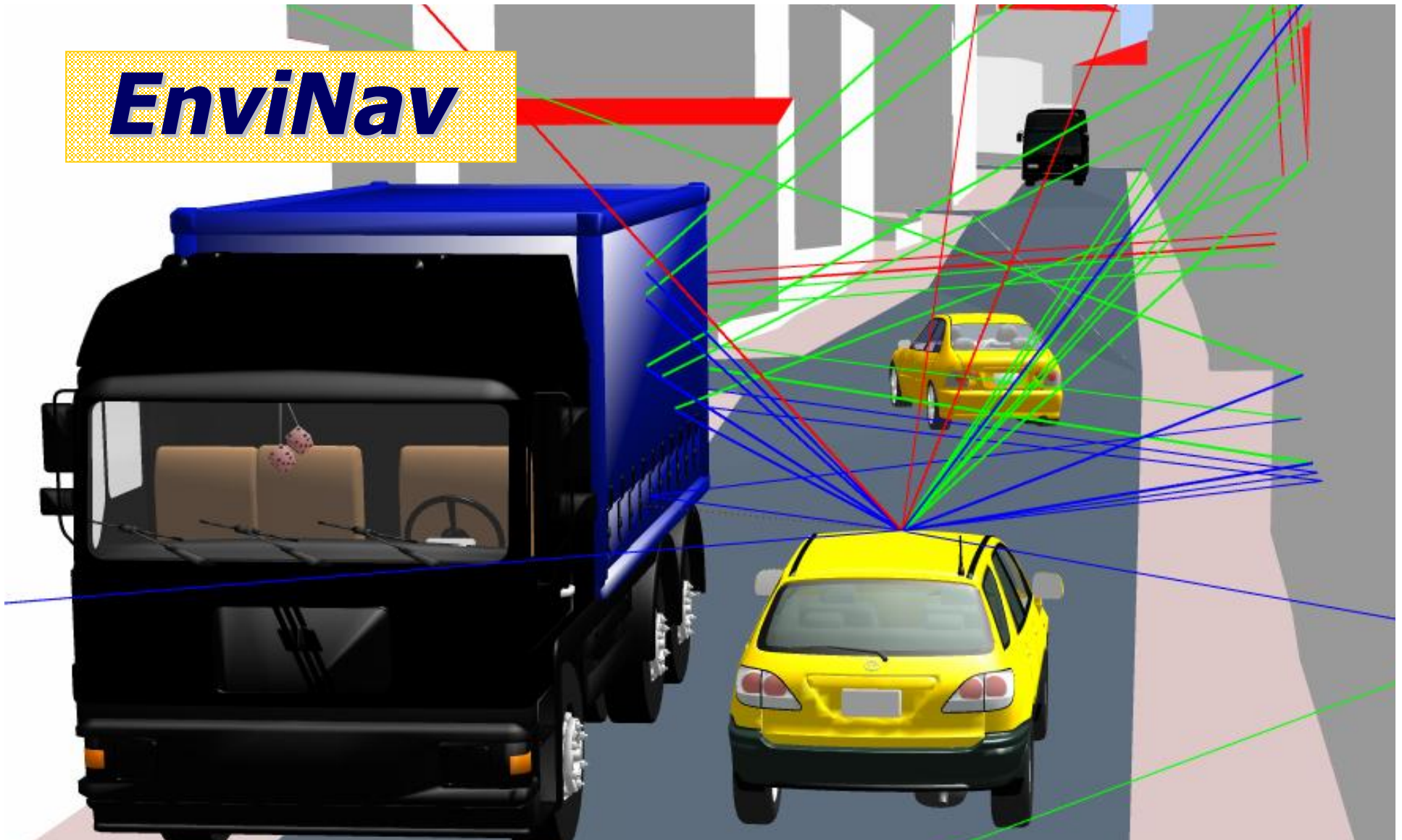


EnviNav



**Deterministic Simulation of Wave Propagation in Constrained
Environments for Navigation and Telecommunication**

Bruno Rémy (Agenium) - Gregory Moura (Ergospace)

AGI User Exchange 2007 – August 29th 2007 - Washington D.C.

Outline

- Agenium and Ergospace overview
- EnviNav main features
- Typical scenarios for Envinav



Overview of the companies



Agenium

Somewhere on that part of the globe

A satellite-style image of the Earth showing the continents of Africa, Europe, and Asia. The text "Somewhere on that part of the globe" is overlaid in yellow.

Agenium Partners

- Analytical Graphics Inc
- Scalable Network Technologies
- Global Imagination
- Trinnovations
- Leica Geosystems and Ionic Software
- Astrium
- Planet Observer
- Ergospace

- Member
 - Open Geospatial Consortium (OGC)
 - Aerospace Valley
 - I-Space



Agenium activities

- French and European partner for US software suites and products
- **Services**
 - Support
 - Training
 - Software Development
 - Consultancy
 - R&D effort
- Industrial computing and especially obsolescence solutions



Agenium customers

- Agencies, Aeronautics, Space, Defense, Telecommunication, Museums
 - Alcatel, Air Force, Arianespace, Airbus, Astrium, CNES, CRERS, Dassault Aviation, DGA, EADS, ESA, Eutelsat, France Telecom, General Dynamics, MoD, Maroc Telecom, MBDA, Sagem, Thales, Thales Raytheon, UIT, ...



Ergospace

- Founded in February 2001 in Toulouse, France.
- Member of CECILE Group and Aerospace Valley (World Competitiveness Cluster Midi-Pyrenees & Aquitaine)



- Main Activities:
 - Development of electromagnetic propagation simulators in constrained environments.



Partners and Customers



Centre National des Etudes Spatiales (French Space Agency)



Laboratoire de Recherches Balistiques et Aérodynamiques
(French Department of Defence)



Institut National de Recherche sur les transports et leur sécurité
(French National Institute for Transport and Safety Research)



Agenium Informatique et Systemes



EnviNav

Main Features

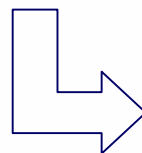
 **ergospace**

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Why EnviNav ?

- **All the STK users of STK/Comm and STK/Coverage performing analysis would like to get more information about the effects of constrained environments on the signal.**
 - **Typical constrained environments:**
 - **Urban canyons**
 - **Indoors**
 - **Mountainous areas**
 - **Reception problems:**
 - **System availability**
 - **Measurement accuracy.**



Intrinsic issues of reception in stringent environments

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What EnviNav does ?

- **Propagation of radio signals in constrained environments**
- **Deterministic modeling of:**
 - Shadowing effects
 - All possible multipaths (reflections, transmissions and diffractions)



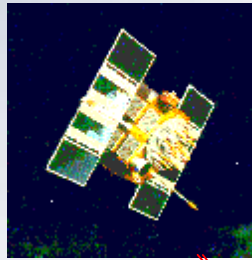
Users of EnviNav

- **Military: Navwar**
(Mission preparation, coverage forecasts, jamming effects...)
- **Civil: navigation and communications**
(Performance evaluation, terrestrial systems design, aid in developing L.B.S. and G.N.S.S. applications...)
- **Space: rendezvous accuracy**

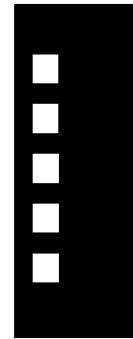
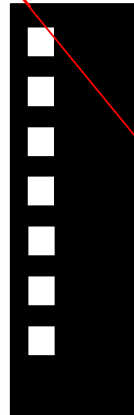
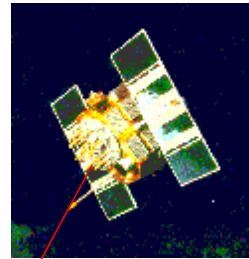


Issue #1

Shadowing effects



Direct Rays

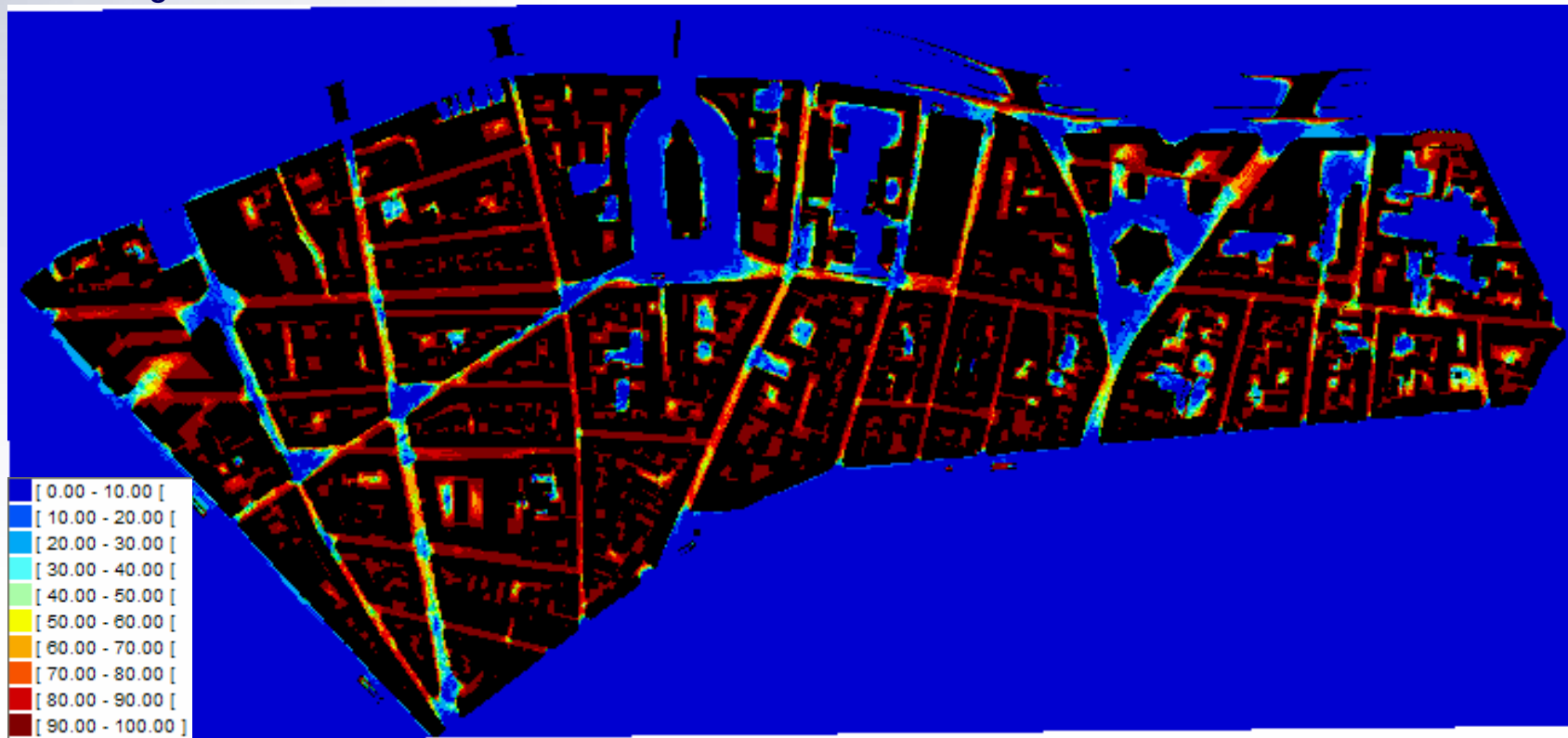


Availability Problems due to environment



Shadowing effects computed

Percentage of simulation time when the received satellites number is less than 4:

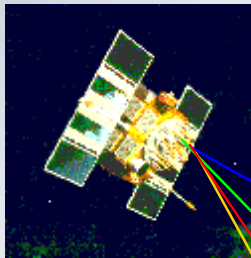


Map built by ergospace®

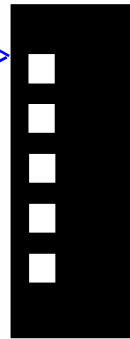


Issue #2

Multipaths



Direct Ray

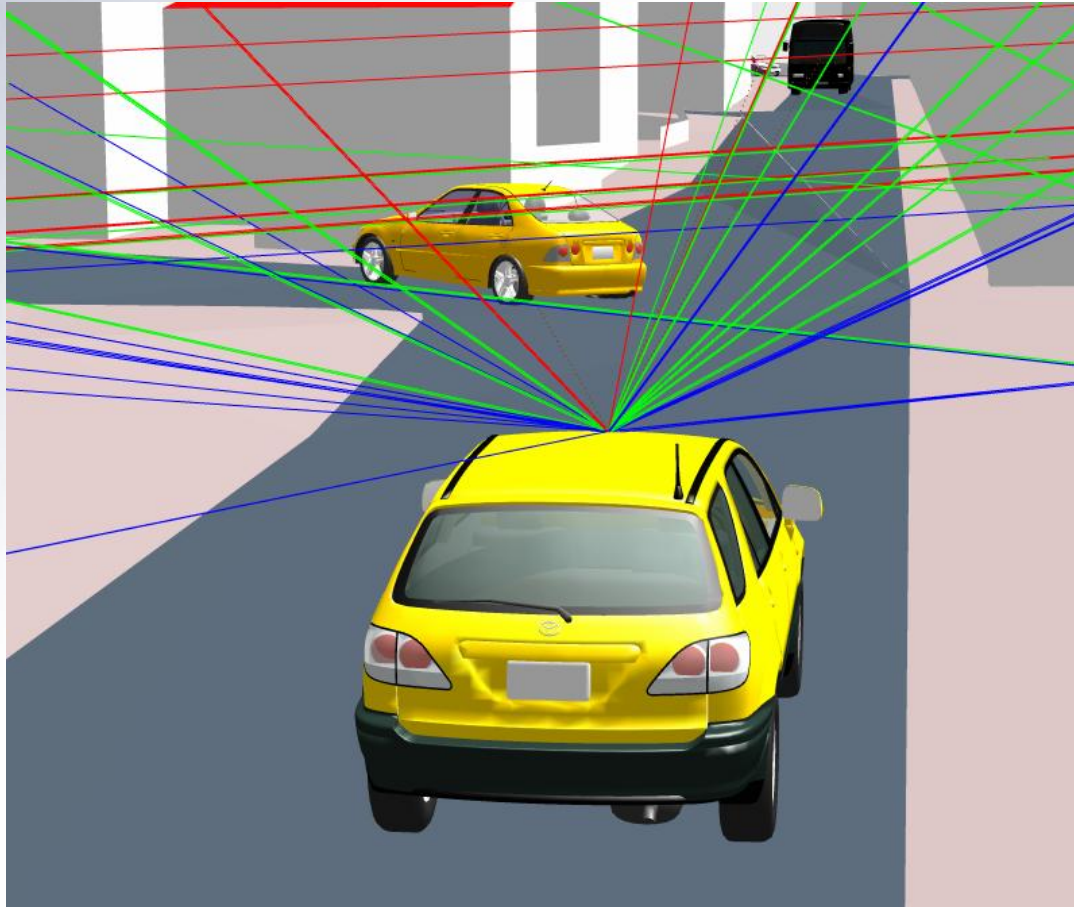


- Reflected Ray
- Diffracted Ray
- Transmitted Ray

Interferences lead to fading effects and impact measurement accuracy.



Multipaths Modeling



- Direct Ray
- Reflected Ray
- Diffracted Ray



Features

- **Simulates the propagation of electromagnetic waves in constrained environments.**
- **Developed jointly by Agenium and Ergospace.**
- **Based on ergospace[®] technology.**
- **Add-on module for STK[®] software suite.**



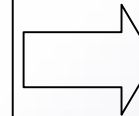
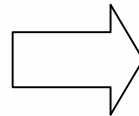
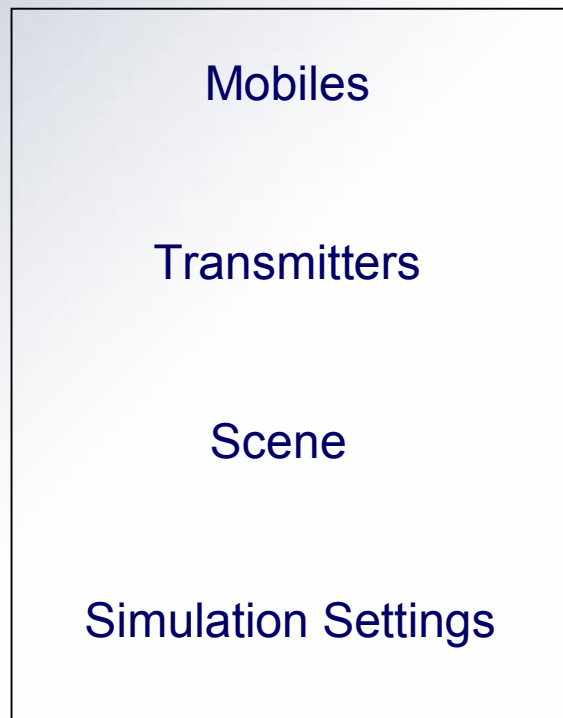
Features

- **Uses the deterministic method of Ray Tracing to compute rays.**
- **Takes into account shadowing effects and interferences due to multipaths.**
- **Provides complete link and error budgets for each path.**



Typical usage

Input set in STK environment



Outputs



Navigation Outputs

- DOPs (Dilutions of Precision): HDOP, VDOP, PDOP, TDOP, GDOP
- Visibilities and InterVisibilities
- Signal dephasing
- Geometrical delay
- Doppler shifts



Electromagnetic Outputs

- Error Budget
 - Clocks
 - Ionosphere
 - Troposphere
 - MultiPaths

- Link budget
 - Signal:
 - Power
 - Frequency

 - Losses
 - Free-space
 - Cabling
 - Multipaths
 - Antenna
 - Atmosphere



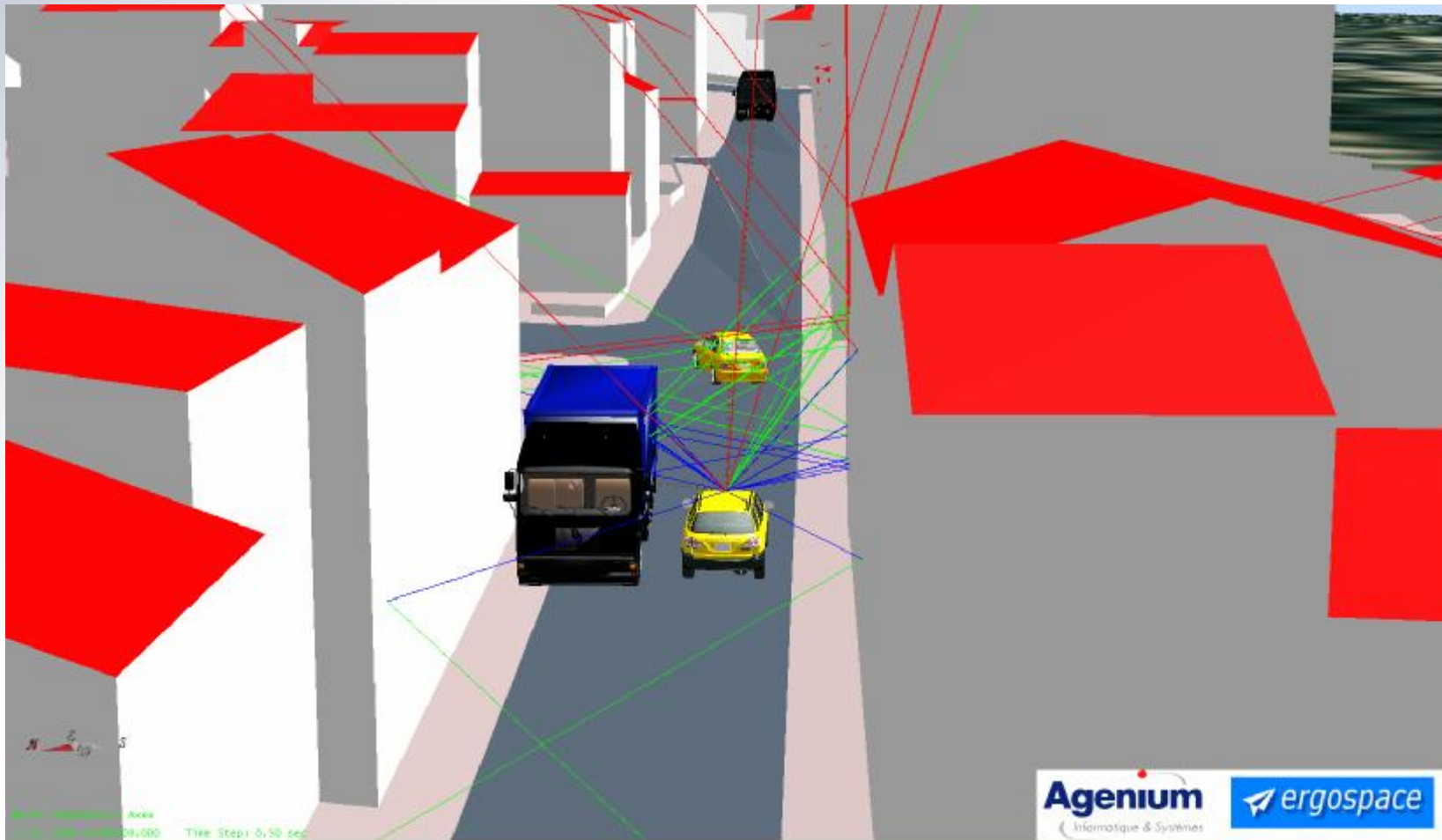
Typical scenarios for Envinav

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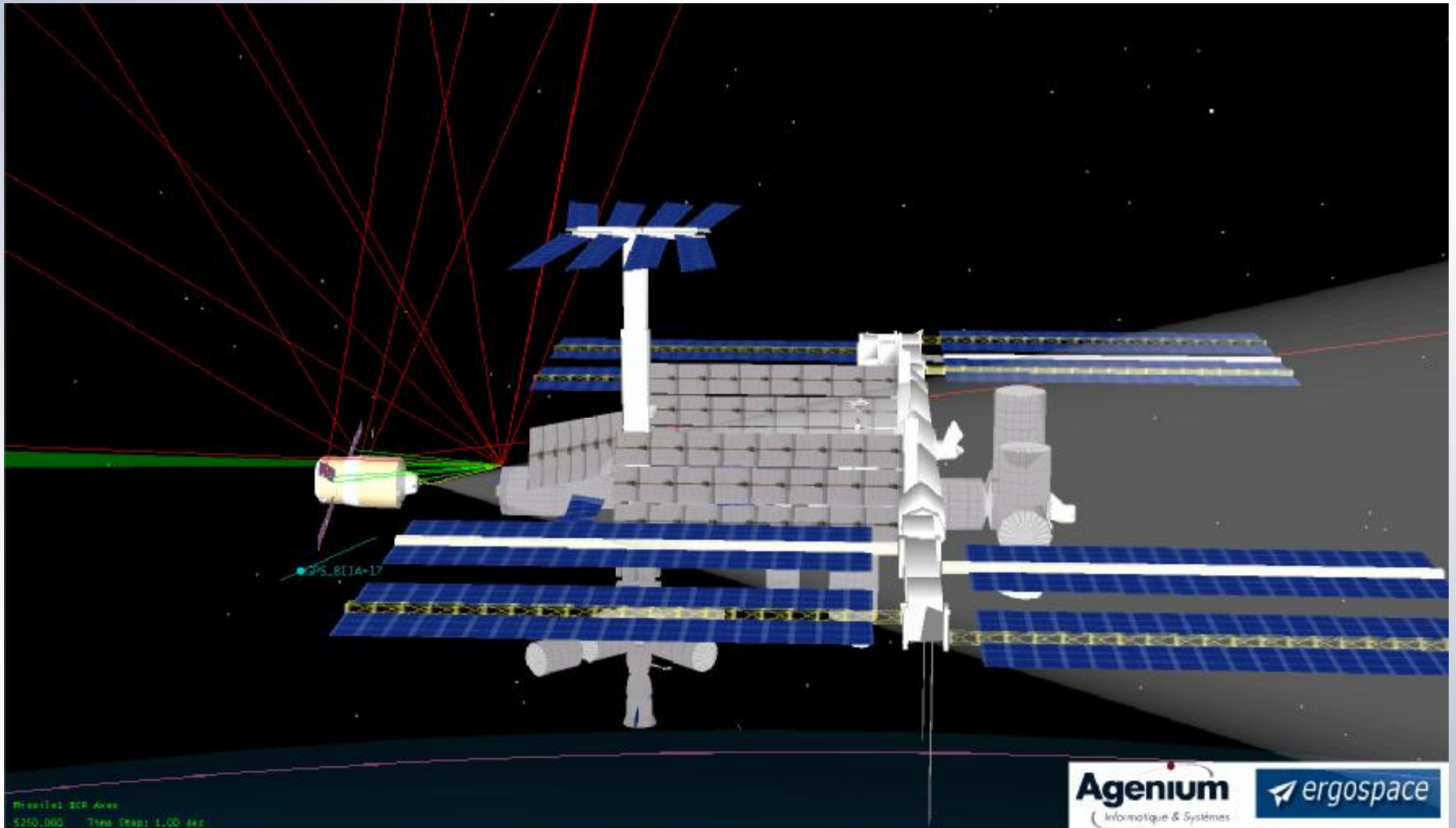
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Urban Canyon



Space Rendezvous



Conclusion

- **EnviNav is a powerful tool to evaluate systems performance in constrained environments for:**
 - navigation
 - communication
- **EnviNav is an efficient tool for**
 - Mission preparation
 - Coverage forecast in stringent environments
 - Evaluation jamming effects
- **Thanks to its high-performance Ray Tracing engine, EnviNav combines calculation accuracy and speed.**
- **Propagation models are validated by the French Space Agency and the French Department of Defense.**
- **Available today as an add-on module for STK**



Thank you

Questions ?

- **Contacts and links**
 - **email : contact@envinav.com**
 - **<http://www.envinav.com>**

