**focusSuite - BASED SOLUTION FOR COLLISION RISK ASSESSMENT**

*focusCloseAp*, is a member of focusSuite, a suite of advanced operational flight dynamic systems used by many spacecraft operators.

*focusCloseAp* shares the main elements of the focusSuite infrastructure:
- Advanced user interface
- Plotting tool
- Automation component

*focusCloseAp* is much more than a COTS product since training, support and customisation can be provided by GMV.

---

GMV AEROSPACE AND DEFENCE S.A.  
Isaac Newton, 11  P.T.M. Tres Cantos  28760 Madrid  SPAIN

GMV SPACE SYSTEMS, Inc.  
1375 Piccard Dr. Suite 250  Rockville  MD 20850  USA  
www.gmv.com
ASSESSMENT OF COLLISION RISKS
- Risks come from uncontrolled objects: Last stages of launchers, failed satellites, dead satellites not parked in graveyard orbit, debris caused by in-orbit explosions, etc.
- Many operators have no collision avoidance policy at all: “The space is too big...”
- Costs of a collision: Hardware, lost revenue, liability
- Few resources are available for collision avoidance, usually the cost is too high (especially for small operators)

GMV’S BACKGROUND IN SPACE DEBRIS
Long experience in the field, in specific contracts with several customers:
- European Space Agency:
  - Responsible for the development and maintenance of DISCOS, a database of trackable objects in Earth orbit
  - CRASS: LEO Collision Risk Assessment Tool, developed for ESOC
  - SSASIM (SSA simulator for ESA): An Earth orbiting object catalogue maintenance simulator
- EUTELSAT: Several studies on collision risk assessment, procurement of a tool
- New Skies Satellites: Development of a customised automated system for close approach detection using TLEs based on focusSuite infrastructure
- Galileo constellation monitoring: CloseAp is integrated in the Galileo Flight Dynamics Facility to monitor the entire constellation and compute collision avoidance manoeuvres in the case of a close conjunction detection the manoeuvre to be performed to minimize the risk of collision.

focusCloseAp FEATURES
Main features:
- Using orbital information, close approaches between the satellite and third-party objects are detected
- If a close conjunction is detected, collision avoidance manoeuvres can be computed
- Support for large fleets of satellites is available with integrated input forms and reports as well as optimised computations

Orbital information obtained from:
- Target satellite: Operational orbit
- Third-party objects: TLEs downloaded from Internet, propagated with SGP + proprietary algorithm to increase accuracy

Catalog Filtering:
- Catalog filtering is a CPU-intensive task (thousands of objects to be considered and propagated)
- focusCloseAp applies firstly the classical apogee-perigee filter, the most efficient one
- A smart-sieve is secondly applied to filter out all other remaining object that cannot yield a close conjunction in the time of analysis
- Accurate root finder is used to compute the exact time of closest approach

Outputs:
- Complete text report provided
- Plots
- Support for large fleets of satellites: Integrated input forms and reports, optimised computation

AUTOMATION CloseAp
- Automation capabilities provided by Autofocus, a component included in focusSuite infrastructure
- Scheduling is easily configurable
- Routine operations of focusCloseAp do not require any user’s intervention:
  - Execution of process (download of data) fully automated (download of data, computations, delivery of e-mails)
  - E-mails sent to configurable list of addresses with the subject of message indicates if warnings were detected
  - Manual use is an option that allows for further analysis and reconfiguration