

Contribution to the NEAT Workshop

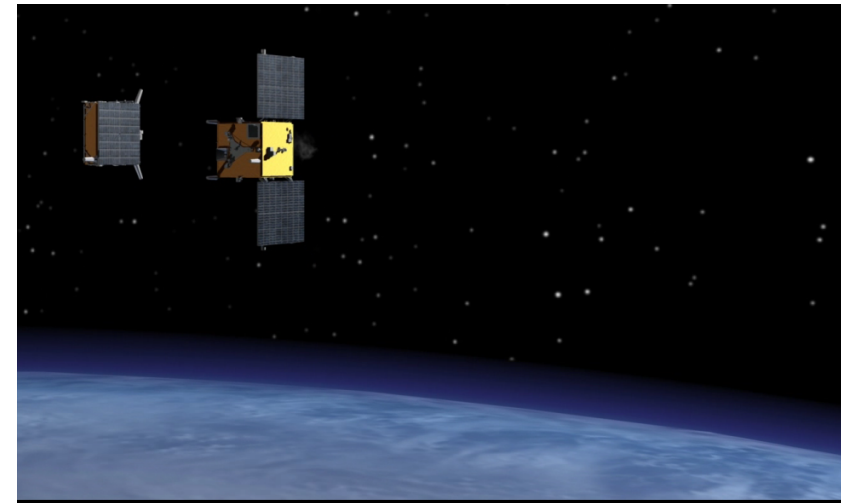
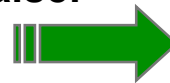
November 21-22, 2011, Bjorn Jakobsson



SATELLITE SYSTEMS

Instrument & Mission / Available Tech, PRISMA related

- Swedish led, multi-lateral international project (SWE 90% of the costs), **two S/C**, operational since June 2010, 5 years effort, 35MEuro,
- **In-Orbit Test-bed** aimed at a variety of demonstrations and experiments in the area of **Multi-Vehicle Capabilities**, such as:
 - Proximity Operations (PROX)
 - Formation Flying (FF)
 - Rendezvous (RDV)
 - On-Orbit Inspection, Service, Assembly (OOSA)
- **TRL (Technology Readiness Level) Raiser** aimed at:



- A variety of **generic GNC capabilities and aspects** in the domain of PROX, FF, RDV and OOSA
- **Autonomy and Operational aspects**
- **Distributed sensor systems**: Visual based (coop & no-coop), GPS based (relative navigation via inter-satellite communication), FFRF (GPS like, formation-local system)
- **Micro-Pulsion** system, targeted towards a proportional thruster system, 0 to 1 mN
- **HPGP propulsion** system, intended as a replacer to hydrazine based systems

PRISMA – What has been done & demonstrated so far? 1(2)



Targetted GNC capability (OHBSwedn)	Category	Relevance for NEAT	Comments
Collision (formation) risk detection and avoidance	Safe Fcn	YES	
Evaporation (formation) risk detection and avoidance	Safe Fcn	YES	
Autonomous T-periodic relative motion	Safe Fcn, OOSIA, FF	YES	
Autonomous VBS based Rendezvous	RDV	YES	
Autonomous GPS based Rendezvous	RDV	NO	
GPS based 3D Proximity Operation	RDV, OOSIA, FF	NO	
GPS based 3D Final Approach & Recede maneuvers	RDV, OOSIA, FF	NO	
GPS based Submeter (wrt ISD) operations	RDV, OOSIA, FF	NO	
VBS based 3D Proximity Operation	RDV, OOSIA, FF	YES	
VBS based 3D Final Approach & Recede maneuvers	RDV, OOSIA, FF	YES	
VBS based Submeter (wrt ISD) operations	RDV, OOSIA, FF	YES	
GPS FF - Celestial Inertial / distributed Instrument	FF	NO	inertial to SLO done on ground,
GPS FF - SLO related / distributed EO Instrument	FF	NO	
GPS FF - LAT/LONG/ALT related / EO distributed Instrument	FF	NO	Lat/long/alt to SLO done on ground
Optical FF - Celestial Inertial / distributed Instrument	FF	YES	Same as above
Optical FF - SLO related / distributed EO Instrument	FF	NO	
Optical FF - LAT/LONG/ALT related / EO distributed Instrument	FF	NO	Same as above
FF – Routine Acquisition & Establishing of a rigid Optical arm	FF	YES	Main perspective has been Break, Cruise, Build, not operational re-acquisition
Optical FF - SLO related / distributed EO Instrument	FF	NO	

Distributed Metrology	Functionalty	Relevance for NEAT	Comments
Vision Based, far range	acquisition, relative orbit navigation	YES	No inter-sat com
Vision Based, close range	Acquisition Coarse & fine translational and rotational control relative orbit navigation relative attitude navigation	YES	No inter-sat com
FFRF ("GPS like" RF based)	Acquisition Coarse & fine translational control relative orbit navigation relative attitude navigation	YES	Any orbit Needs inter-sat com
GPS Based relative navigation	Acquisition Coarse & fine translational control relative orbit navigation	NO	LEO, GEO, HEO Needs inter-sat com

Distributed sensors

Propulsion

Propusion technology	Functionalty	Relevance for NEAT	Comments
Micro-propulsion	Fine translational control	YES	Proportional thrust
HPGP	coarse translational control	YES	Easier handling as compared to hydrazine

An Idea – Avoid the "FF-Word"?
 The "FF label" itself appears to be loaded with some, for NEAT and NEAT like missions, **very problematic connotations** like: FF is daring, is difficult, is acrobatic, circus & equilibristics, etc
Avoid "FF" – instead, be more specific and replace "the FF word" with more explicit phrasing, that do not allow these "culturally/emotionally "negative" associations.

An Idea – Alternative organizational setup? (the cost issue)
 maybe a NEAT like mission should best be implemented in a bilateral, trilateral setup entirely outside ESA?

An idea – A NEAT Evolution? (the operational lifetime issue)
 maybe a NEAT like mission could be implemented in (chronologically) stepwise, (system) evolving manner, like three launches, three generations of the NEAT Instrument, three levels of measurement capability, each generation providing unique and valuable science, going through a good / better / best sharpening of the NEAT science/knowledge
 three missions, each one being BOTH a precursor and provider of a permanent building block for the subsequent launch and of the evolving NEAT Instrument

An idea – Alternative approach?
 OOA is so much more than ISS, **On Orbit Assembly? Servicing? Propellant? Sharper Detector, Sharper optics?**

Go for it NEAT!
You can Break the Size Barrier
for Space borne Telescope / Instruments

From a PRISMA perspective
You NEAT people ...Go for it! ...make a really Big and Sharp Instrument,
Via multi-vehicle approaches several alternatives are possible

The cooperating agencies and partners have, through the demonstrations on PRISMA, shown and proven that:

- multivehicle capabilities such as autonomous proximity operations, formation flying and rendezvous
- are technologies now actually available and accessible on a "shoestring" budget and
- manageable even for smaller companies and organizations.



- Movie – accumulated experiments movie
- Movie – proximity operations

- An invitation – Possibility for NEAT? setup a NEAT specific (or NEAT oriented), PRISMA experiment, to possibly add/strengthen the “next round” of NEAT proposal/s

Characteristics relevant for NEAT:

- repeated reorientation,
- autonomous coordination of the rotational (RW based) & translational (thruster based) control of the two units,
- optical metrology for the relative positioning, (lateral and longitudinal),
- startracker based attitude control.

- Obviously not exactly in a shape that would be expected in a NEAT implementation
- and not at same longitudinal accuracy
- and not the same operating range of the optical system for the relative position measurements,
- not with the same precision in the attitude control on both units,
- orbit, etc, etc



These are Available on Prisma:



There are many differences, **but there are also many similarities:**

qualification and demonstration by similarity is a valid approach for certain capabilities in many situations.