NEOShield-2

Project overview and results so far

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NEOShield-2
Science and Technology for Near-Earth Object Impact Prevention
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Project Overview
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 640351.
Results so far
Reference Space Missions

Defined reference space missions:

• Fully fledged, 2 S/C
• NEOTωIST
• Sample Return
Technology Development

Harmonized development approach + independent evaluation of 3x autonomous visual GNC+IP

• Impactor S/C (see dedicated poster)
  – TRL4: end-to-end intensive functional validation
  – TRL5 on-going: real-time validation on space target processor
  – TRL5+: Experiment on camera optical stimulation

• Reconnaissance S/C critical modes TRL5+
  – Close Approach → safe reduction of velocity towards NEO in 3 days
  – Arrival Inertial Hovering → maintain safe state after arrival during 6h before ground control
  – Body-Fixed Hovering → observe a sub-Nadir surface point and/or prepare for lander release or decent/landing
Technology Development

Sample Return S/C
• Full landing scenario
• V&V in MIL, PIL, HIL (including OBC, camera and altimeter) environments up to TRL5+

Real-time Test Facility & Test Campaigns
Validation campaigns + tests of the three GNC missions including representative navigation camera:
• HIL-OPT: nav CAM stimulated by screen & SurRender generated images (developed by Airbus)
• HIL-ROB: nav CAM stimulated by asteroid mock-up in GMV’s platform-ART robotic laboratory
ODM to assess β-factor (Poster)

- Determine the β-factor allowing to extrapolate demo results
- Quantify in short-term impact effects and to evaluate success
- High fidelity ODM, IP and dynamics model validated with Monte Carlo campaign

Sampling Device

- Powder actuated bolts breakup asteroid rock
- Compressed gas fluidizes loose regolith and broken rock material into separate storage chambers
Physical characterization of “small” NEOs

- Thermal IR: No observations, but new thermophysical modelling of several NEOs and Mars Crossers
- Precovery of several NEOs via searches in Pan-STARRS-1 data (light- and phase curve amplitude estimation possible in some cases)
- Light-curves of ~30 objects (mainly at 1-m French telescopes OHP & PdM)
- Phase curves of ~15 objects (at 1-m OASI-Itacuruba, Brazil)
- Photometric colours of ~150 objects (mainly at 3.6-m TNG, Canary Islands)
- Visible spectroscopy of ~150 objects (mainly at 3.6-m ESO-NTT, Chile)

Preliminary results from NTT spectroscopy:
- Left: size distribution of the 137 targets for which we obtained good S/N data (we doubled the literature for this size range)
- Right: obtained distribution of taxonomical types. Unexpected abundance of A- and D-types within the small NEO population (vs. literature for larger sizes)
• **Statistical Analysis:** Correlations between infrared data, radar albedo, spin period, etc., reveal how IR observations of asteroids can provide insight into:
  – Mineralogy, especially metal content

• Dynamic models focusing on **ejecta fate modelling** after an impact have been developed and applied to the AIDA and the NEOSHIELD 2001 QC34 scenario to identify for instance:
  – Ejecta dynamics and environment clearance mechanisms
  – Safe positions for reconnaissance S/C during and after impact

Yang, Michel, Schwartz 2017. Icarus 282, 313
NEO Properties Portal, Mission targets

• Observation & Characterization results (raw, intermediate + final data products)

• Observational support tools
  – Supports coordination of NEO observation campaigns
  – Prioritization of observational targets to maximize the return from telescope time allocations

• Dynamical Web Interface
  – NEO accessibility + “Mission Opportunities tables”
    → potential mission targets lists for scientific exploration (rendezvous/return) and deflection demo missions

[Image of NEO Properties Portal]

http://neoshield.eu/neopp
Conclusions

• Key technologies for kinetically impact, proximity operations at and landing on small NEOs (<=300m)
• Fast & precise ODM technique (β-factor)
• Novel sampling device
• Physical properties of numerous small NEOs
• Method to derive mineralogy/metal content and surface structure from IR observations
• Impact ejecta dynamics modelling
Thank you for your attention!

Questions?

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