HPS
High Performance Space Structure Systems GmbH
GERMANY

HPS - THE TEAM TO TRUST

TIME TO ACT

More than **30,000 new on-orbit spacecraft** endanger mission sustainability.

esa

Note: Debris artist's impression by ESA; size of debris exaggerated as compared to the Earth; ADEO funded/co-funded under ESA-GSTP program.

CleanGreenSpace Missions

Deorbit dead satellites and expended launchers fast and reliably with our deployable dragsail:

ADEO
DE-ORBIT SUBSYSTEM

ADEO products are suitable for **satellites & launchers** (1-1,500 kg) de-orbiting from **LEO** (< 900 km)

Platform: P200, courtesy of QinetiQ Space. Deorbit System: ADEO-L, courtesy of HPS GmbH

HPS Germany is a "turnkey supplier" for commercial passive deorbiting subsystems based on deployable sails.

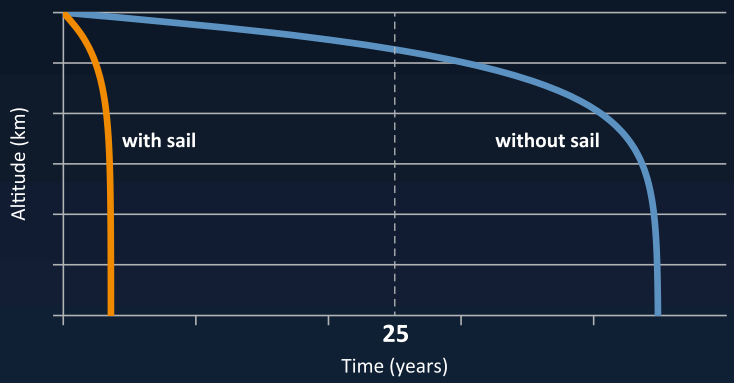
CleanGreenSpace Missions are enabled through utilizing the residual atmosphere by a drag-sail to decelerate for a significantly quicker annihilation in reentry-fire than without a sail.

Based on the collaboration with renowned international partners and development projects funded/co-funded by ESA, the Bavarian Ministry of Economics as well as the German Space Agency DLR, HPS realized an industrial complete ADEO-product family for the return of all kinds of spacecraft and satellites:

ADEO-N (Nano for S/C with 1 – 250 kg)
ADEO-M (Medium class for S/C with 100 – 700 kg)
ADEO-L (Large for S/C with 500 – 1,500 kg)

Unique features of ADEO are:

- **secured deorbit** from LEO (<900 km)
- **ultra-lightweight** (lower mass than additional propellant for active de-orbiting)
- **scalable sail size** (2 m² to > 100 m²) tailored to each spacecraft mass
- **generic** (standard interfaces with adjustable interface brackets to spacecraft)
- **completely passive** (no need for active control, if demanded: own battery with dead man switch for autonomous deployment).



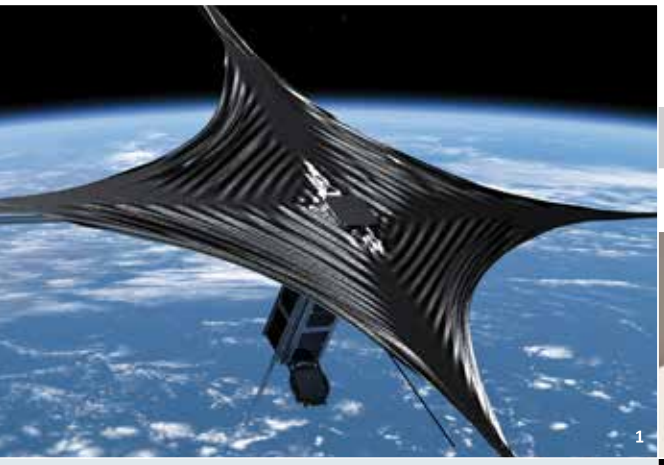
A collaboration of:

Funded/ co-funded by:

Contact:
+49 (0)89 4520 576–0
@ stelzl@hps-gmbh.com
www.hps-gmbh.de

Flyer:

Homepage:

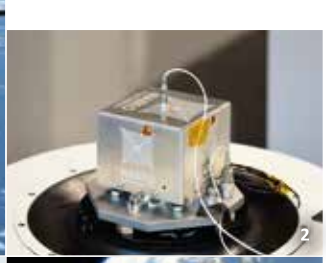


1: Animation of ADEO-N de-orbiting a 3U-Cubesat *(Cubesat: © ORORATEC, Animation: © HPS)*

ADEO-N

Technical Features:

- Initiation of the deployment via a simple signal
- Two-step deployment: 1) out of the box; 2) sail deployment (allowing the subsystem also to be used in 6U, 12U, … cube satellites and rocket bodies).
- Dragsail area: 2 m² up to 7 m²
- Stowed size: 1U (10 cm x 10 cm x 10 cm).
- Mass: 1 kg.



2: ADEO-N1 during vibration qualification test in stowed configuration *(© test performed at Fraunhofer EMI)*
3: ADEO-N1 launched in 11/2018 onboard ELECTRON *(© Rocket Lab USA)*
4: ADEO-N2 on D-Orbit launched in 2021 *(© D-Orbit)*

General Description:

- Dragsail for cubesat/nano-satellite and rocket body applications (1 kg-250 kg S/C)
- Completely passive de-orbiting without GNC within 25 years or much shorter like 3-5 years, if needed.
- Customizable sail areas depending on spacecraft mass and deorbit time needs.

Mission Examples:

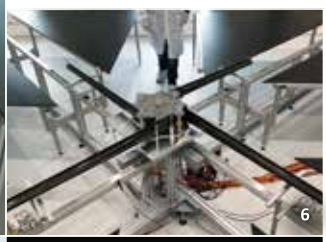
- ADEO-N1 (NABEO, 2018-2019): First mission called “Pride of Bavaria” dragsail, launched from New Zealand on Rocket Lab’s Electron mission called “It’s Business Time” (launch sponsored by Rocket Lab and Ecliptic, USA).
- Parabolic Flight (2019-2020): Detailed investigation of deployment behavior under 0-g, tailoring of design w.r.t. reliability and mass.
- ADEO-N2: Mission “Show me your Wings” launched in June 2021 with D-Orbit’s (Italy) ION “Wild Ride”
- Next launches targeted for 2022 within the ESA's GENA-Sat activity
- Pre-developments for constellation- and small launcher applications in 2022-2023.

5: Section of ADEO-L Engineering Model (deployment testing on ground at DLR-Bremen)

ADEO-L AND ADEO-M

Technical Features:

- Motorized deployment
- Own deployment control electronics
- Optional: own battery for autonomous deployment in case of satellite failure
- No onboard GNC required
- Dragsail area from 7 m² to > 100 m²
- Stowed size: 40 cm x 40 cm x 17 cm
- Mass: 7-15 kg (depending on sail size)



6: ADEO-L Engineering Model (deployment test on ground)
7: Animation of 25 m² ADEO-L with a 0.8 m x 0.6 m x 1.2 m satellite with a satellite mass of 300 kg during atmospheric entry

General Description:

- Scalable drag-augmentation subsystem to passively deorbit satellites and rocket bodies between:
  - 100 kg and 700 kg (ADEO-M) or
  - 500 kg and 1,500 kg (ADEO-L)
- within 25 years (or much shorter, like 3-5 years, if needed)
- Customizable sail areas depending on spacecraft mass and deorbit time needs.

Mission Examples:

- ADEO-L1 (2014 - 2017, in contract to ESA): development of Engineering Model; extensive test program (deployment in hot and cold TVAC conditions, vibration, rapid decompression, numerous material level testing).
- ADDA (2017, in contract to ESA): detailed dynamical analysis considering various perturbations (tumbling, SRP, …)
- ADEO-L2 (2018 - 2020, in contract to ESA): development and production of a PFM with launch in 2023 onboard an ESA/EC IOV-spacecraft built by QINETIQ SPACE (BE).