The Role of Photonics in New Space

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What is ‘New Space’ ?

New Space - increasing commercialisation and democratisation of space

Characterised by:

- Cheaper access to space
- Commercial focus
- Funded by private capital
- Less dependent on government institutions
- Innovation and an appetite for risk
- Significant shortening of the design cycle
- Smaller lower cost platforms
- Use of COTS

1968

2000

Who are New Space?

Launch Vehicles + Space Tourism + Moon Exploration

SPACEX · BLUE ORIGIN · STRATOLAUNCH SYSTEMS · Masten · ASTROBOTIC · ROCKET LAB · WORLD VIEW · Vector Space · FIREFLY · GALACTIC · S3 · BLOOSTAR · ARCA

Satellites + Subsystems + Miscellaneous

Terra Bella · planet. · DAURIA AEROSPACE · spire · OneWeb · SPACEVR · URTHECAST · AXELSPACE · OmniEarth · PLANETIQ · LEOSAT · ASTRO SCALE · aquila space · PLANETARY RESOURCES · ICEYE · TEMPUS · DSI · NovaWurks · SpacePharma · BLACK SKY · SATELLOGIC · HERA · OUTERNET · Accion SYSTEMS · PHASEFOUR

Ground Stations

RBC SIGNALS · ATLAS Space Operations · SPACEFLIGHT · Leaf Space Simplify access to Space · KSAT Kongsberg Satellite Services

Value-added Services

Orbital Insight · Descartes Labs · Weather Analytics · VRESSON · CARTODB · SPACE_KNOW · Ursa · mavrx · MEASURE · MapBox · ENVIEW · WINDWARD · AIRPHRAME · RS Metrics · SLANTRANGE · farmshots · ceresimaging

Mapping of Newspace startups – Europe

Satellite operation constellation & Exploration

hiber · OQ TECHNOLOGY · KLEOS · aerospacelab · ASTROCAST · ICEYE · unseenlabs · PT SCIENTISTS

Suppliers

Thruster / Launch

ThrustMe · exotrail · ISIS · ORBEX · PANGEA · OHB · LENA SPACE · comat · ENPULSION · PLD SPACE · SKYRORA

Equipment/Component

LEAFSPACE · AAC Microtec · weeroc · NAWA TECHNOLOGIES · airborne · HYPERION TECHNOLOGIES · CISLUNAR INDUSTRIES · KALRAY · INUENT · cailabs · AirMems · NanoRaven · nano avionics · OXFORD SPACE SYSTEMS · GOMSPACE

Software

aiko · Quadrille · ROKUBUN · KRONO-SAFE · numalis · Mapping by XAnge · syntony · delfox · farjump · innoflair

Data Analytics / imagery

EARTH CUBE · Rezatec · eodyn · KAYROS · aerospacelab · Picterra · DESCARTES · geoflex

Engineering services

space · SPACEPHARMA · ALEN · MADRIDSPACE · sonaca space · OUTER · REALTRA · DIOTA

To send us information regarding your Newspace startups, it's here

Sources: Guilhem de Vregille, Léa Philippot – VCs @ XAnge

The contribution of Photonics and Optics in “New Space”

Satellite Scientific Payloads:

- Optical passive instruments such as cameras, spectrometers etc
- Optical active instruments i.e miniaturised LIDARs

Satellite Telecom Payloads:

- Laser communication terminals (Downlinks To Earth and Inter-satellite Links)
- Photonic digital interconnects
- Microwave Photonics for frequency distribution and conversion

Satellite Platforms:

- Miniaturised Inertial Measurement Units (fiber optic or microphotonic Gyro?)

Reusable Launchers and Space Transportation Vehicles:

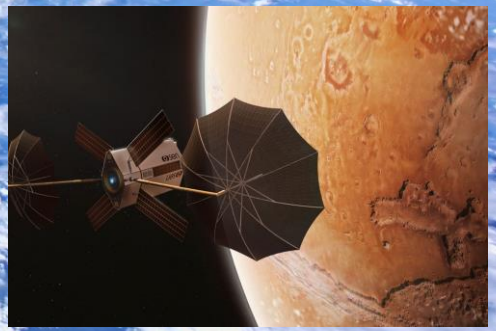
- Fiber optic sensing
- Fiber optic communication links
- Proximity Sensors: – Cameras and LIDARS (also for planetary landers and rovers)
- Opto-pyrotechnics

Example: Optical Cameras in Space

Sen to launch ‘Earth TV’ satellites
Stream real-time HD videos from space to billions of people
1st application HD cameras on 16U nano-satellites in LEO
NanoAvionics to build the first 5 –for Sen

Applications:
- Disaster monitoring
- Climate change
- Marine AIS
- Orbital Servicing

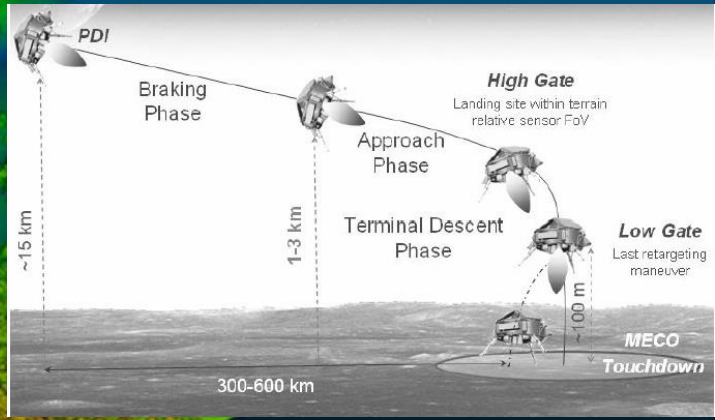
Other Linked Technology:
- Dynamic Filtering
- In combination with digital processing and AI there are endless application possibilities



Example: Miniaturised Imaging LIDAR in Landers

Applications of Imaging LIDARs

- Controlled soft landing of spacecraft on planetary bodies
- Navigation and guidance of rovers and robots
- Rendezvous and docking
- Detection and rendezvous between spacecraft and asteroids
- Monitoring of large deployable surfaces like antennas, solar panels or airbags
- Optical metrology for spacecraft formation flying
- Examination of spacecrafts external surfaces for integrity verification and damage detection
- Morphological characterization of asteroids
- Space debris removal and orbital servicing
- Spin-in from UAV and driverless car markets



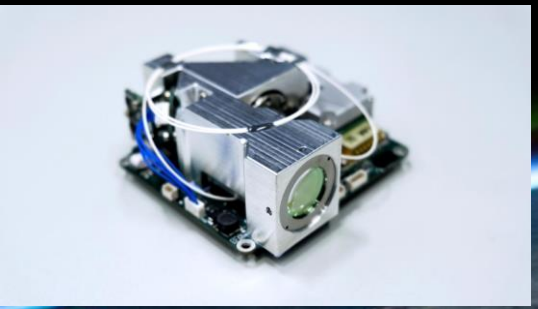
Imaging LIDARs for Space Applications, J. Pereira do Carmo et al. Proc. of SPIE Vol. 7061, 2008

Example: Laser Communication Terminals for Cubesats

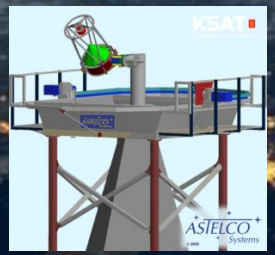
TESAT

Other Linked Technologies:
Adaptive Optics
QKD

GOMSPACE

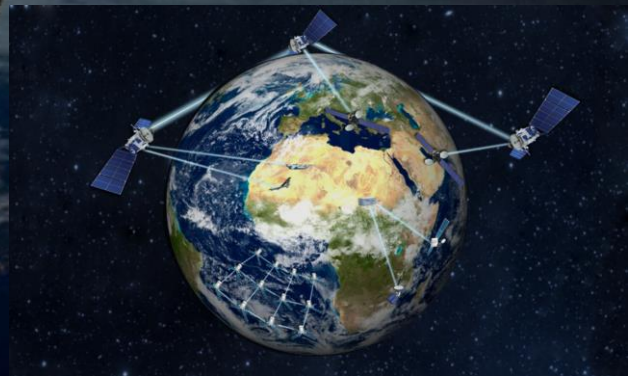


Cube-L the world's smallest optical communication terminal
Size: 95x95x30mm
Weight: 300g
Data downlink: 100Mbps



KSAT
KONGSBERG SATELLITE SERVICES

Data bandwidth
Security



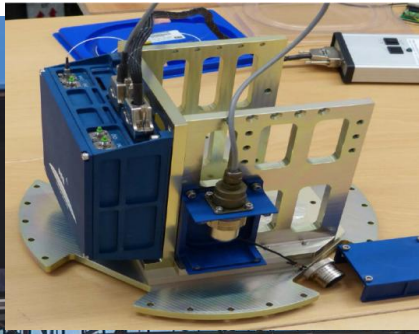
Images courtesy of TESAT, GOMSpace and KSAT

Photonics in Reusable Space Transportation Vehicles

The rise of space tourism and reusable ST vehicles require structural health monitoring

MPB Communications Inc.

MPB's fibre optic health monitoring system on DLR's ROTEX re-entry experiment



ESA's Space Rider will have a SHM system – fibre optics under consideration

Technobis group

X-gator being developed for aerospace – spin-in potential

Integrated Photonics

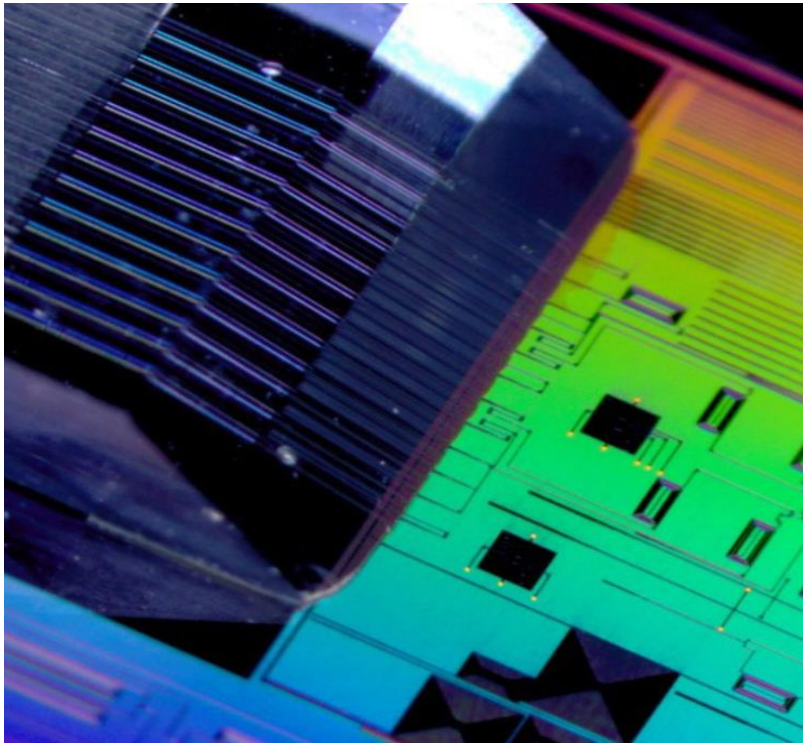
Big part of "New Space" is about making things more efficient in mass and volume

Integrated Photonics fit the objective:

- With reduced Size, Weight
- Increased Reliability

Potential to be considered in many space applications:

- Imaging LIDAR
- QKD transceivers
- Spectroscopy
- Optic Sensing – rotation, strain, temperature, pressure, chemistry and medicine.

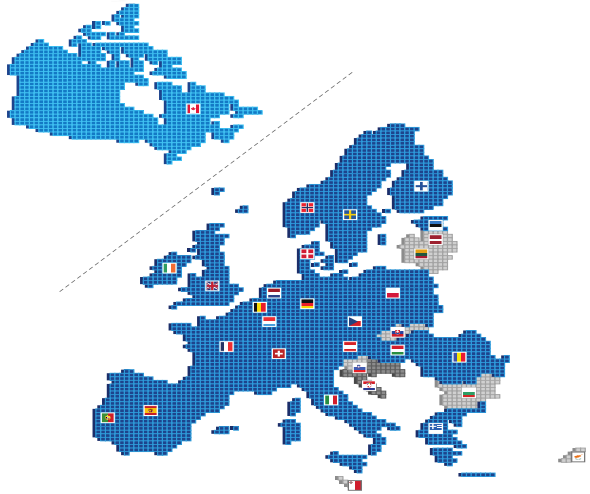


Picture Courtesy IMEC & Tyndall - ACTPHAST

What can ESA do for you?

- Knowledge Centre
- ✓ >50 years experience of space flight
- ✓ Provides an unbiased assessment, untainted by commercial interests

- Funding Centre
- ✓ ESA initiated developments
- ✓ Industry initiated developments



..so talk to us…!