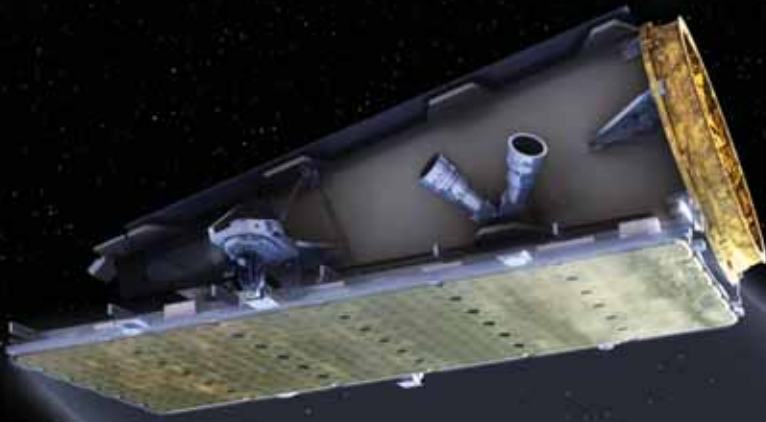


NovaSAR-S

the small satellite
approach to Synthetic
Aperture Radar

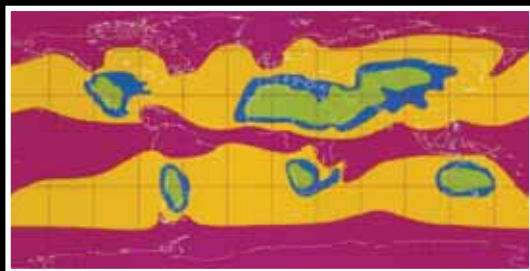


A new benchmark in affordability and performance
for responsive spaceborne radar

Introducing NovaSAR-S



NovaSAR-S will provide day and night coverage



Global Cloud Cover. Picture: Spot Image



What is SAR?

Radar signals can overcome the main drawback of traditional optical imaging satellites by being able to take an image of the Earth through clouds or even at night.

Synthetic Aperture Radar is an advanced form of radar which makes use of the relative motion between the satellite and the target as it orbits the Earth to form a high resolution image.

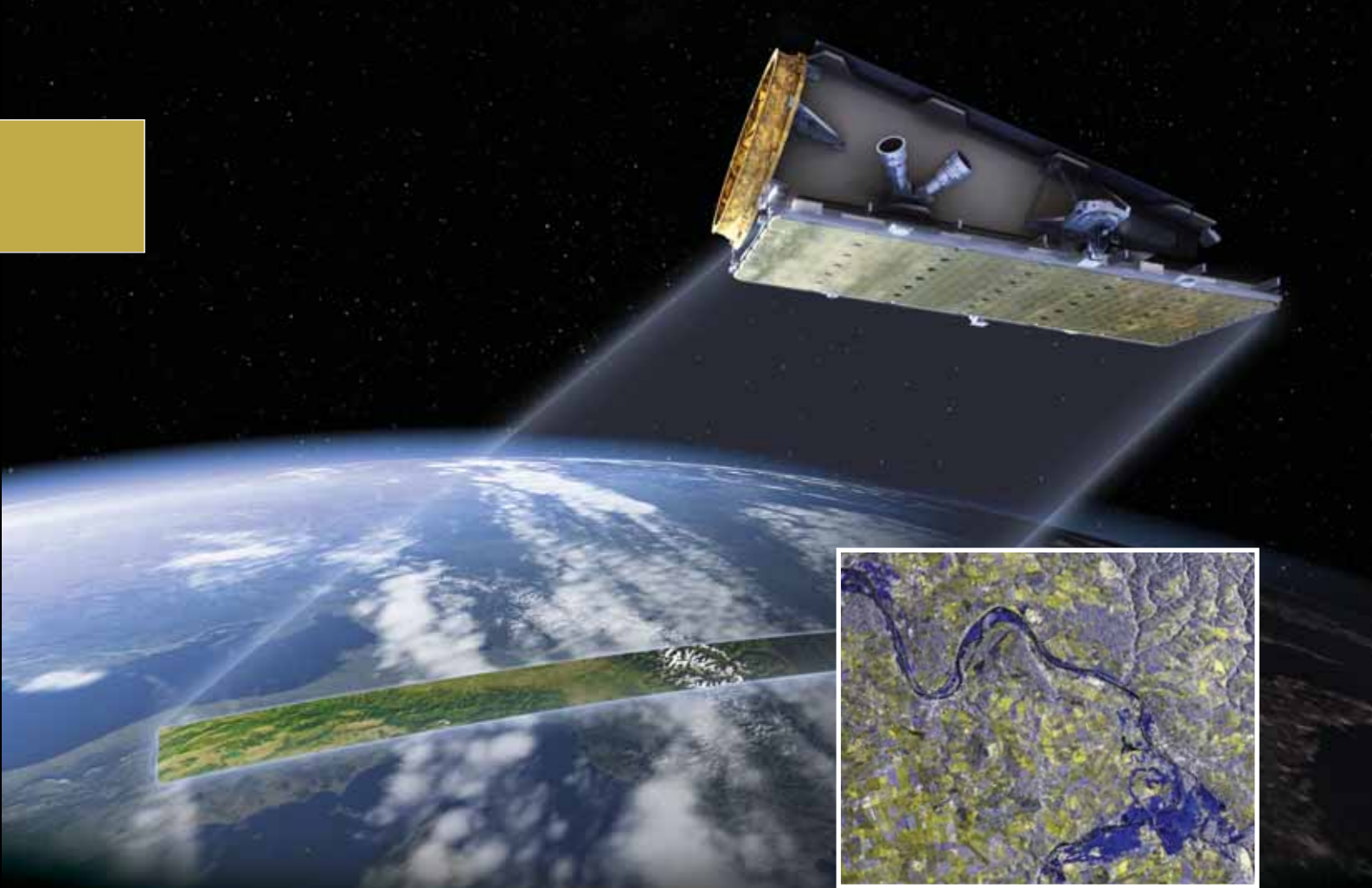
NovaSAR-S is a revolutionary concept in Earth observation - a small Synthetic Aperture Radar (SAR) mission designed for low cost programmes using a combination of the latest commercial off-the-shelf technologies and SSTL's tried and tested approach in delivering low cost small satellite missions. SSTL has teamed with SAR experts at Airbus Defence & Space to develop a highly flexible system that can support end-to-end solutions for numerous applications.

Radar imaging for uncompromised access

NovaSAR-S is capable of imaging any point on the globe, day or night and through clouds. A constellation of three satellites can image any point on the globe every day, regardless of daylight or weather conditions.

The NovaSAR-S core system has been developed from flight proven technology. A fully operational mission can be delivered in 24 months.

- S-band Synthetic Aperture Radar
- Low cost lightweight small satellite design
- Wide range of applications
- Designed for low cost high performance missions
- Complementary to optical satellites
- Capability to image day and night and through cloud



Picture: ESA 2002

Operational capability from the world leader in small satellite technology

Affordable

NovaSAR-S is the lowest cost SAR mission available on the market offering significant programme savings when compared to many traditional SAR missions, and is more affordable than conventional optical satellites.

Responsive imagery

NovaSAR-S will provide at least 1 million km² per day of cloud-free data with guaranteed time-to-target observation capability.

Reliability

The NovaSAR-S core platform and subsystems have flight heritage proven from existing SSTL missions in orbit. The same methodology has been applied across >40 operational satellites demonstrating 100% mission success over the last 10 years.

Direct command and control

NovaSAR-S is available for independent ownership and control. Direct in orbit tasking and encrypted data downlink provides rapid surveys of major natural disasters.

Responsive access

NovaSAR-S is designed to operate independently or in a constellation model similar to the highly successful Disaster Monitoring Constellation, maximising acquisition opportunities by sharing access.

Designed for Low Cost Launch

NovaSAR-S has been optimised for shared launch opportunities, taking advantage of SSTL's launch procurement expertise.

High Performance

NovaSAR-S has a flexible range of operating modes from high resolution to wide area coverage.

Medium resolution applications

Flooding

NovaSAR-S is particularly suitable for rapid and large scale flood assessment when optical satellites are limited due to cloud cover. Flooded areas are easily detected by S-band SAR and can be highlighted on standard maps using change detection techniques.

Disaster Monitoring

NovaSAR-S will provide rapid response imagery to support disaster relief planning and operations as well as damage assessment.

Forestry

Spaceborne SAR is well suited to detailed forestry assessments since a large proportion of the world's forests are found in tropical areas where cloud cover is prevalent and at higher latitudes with low illumination during winter months.

Maritime

- NovaSAR-S is equipped with a super wide 750 km maritime mode for ship detection across oceans.
- Conventional SAR modes can be used to assess particular targets in more detail.
- Ship wake detection can be used to determine speed and heading.
- ScanSAR modes will detect oil spill in coastal areas and open ocean.
- Combining SAR and AIS data will provide additional information for shipping, fishing and customs authorities.



S-band Forestry

Crop monitoring and classification

NovaSAR-S supports agricultural applications including classification of crop type, mapping agricultural land, assessing crop condition and moisture content.



NovaSAR payload demonstration of crop classification

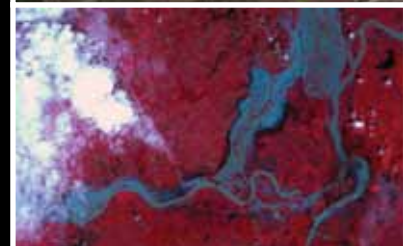


Land cover and land use classification

NovaSAR-S data can distinguish differences in surface roughness, moisture content and geometry of different land surfaces, making it ideal for identifying and delineating between different land types.

Ice Monitoring

NovaSAR-S will monitor large areas of ice formation in polar latitudes where there are long periods of darkness during the winter months.



NovaSAR - A new benchmark in affordability and performance

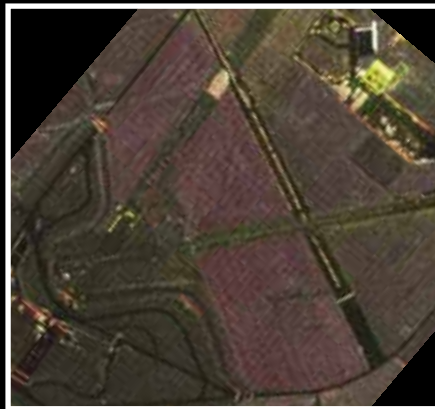
SSTL has been delivering small satellite missions for more than 30 years – longer than anyone else in the world – giving us the experience to justify our reputation as the world's premier provider of operational and commercial satellite programmes. SSTL designs, manufactures and operates high performance satellites and ground systems for a fraction of the price normally associated with space missions, with over 400 staff working on turnkey satellite platforms, space proven satellite subsystems and optical instruments.



S-band for truly low cost SAR capability

Our applications driven approach has resulted in a SAR system which is truly low cost. NovaSAR-S is compatible with low cost launches, supports flexible imaging modes, provides attractive imaging throughput, and is supported by a development programme that includes ground and airborne demonstrators.

Airfield S-band SAR image comparison with optical



S-band



© Google Earth (optical)



Reliable SAR capability

NovaSAR-S combines SSTL's flight proven spacecraft subsystems with an imaging payload that has been developed by an accomplished spaceborne SAR team at Airbus Defence & Space, fusing heritage SSTL-300 avionics with state of the art S-band solid state power amplifier technology to achieve impressive imaging performance. Major milestones completed include:

- Airborne trials validating S-band imagery
- Spacecraft Preliminary Design Review
- Payload demonstration to produce inverse SAR image of International Space Station
- Successful demonstration of avionics suite currently operational onboard NigeriaSat-2

An airborne demonstrator has been tested to validate the payload chain. In the same trial S-band data was shown to provide utility for a variety of applications.

S-band payload airborne trials

Flight trials show that S-band is useful for a range of applications

Pembroke River image comparison between optical and SAR



S-band



© Google Earth (optical)

Maritime use: Shipping clearly detectable in Pembroke dock

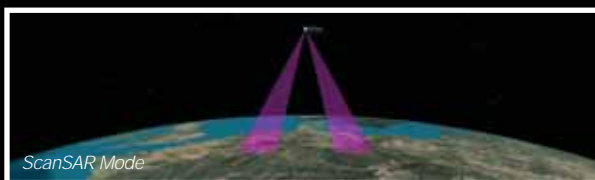


S-Band

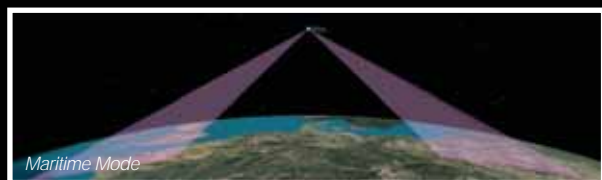


© Google Earth (optical)

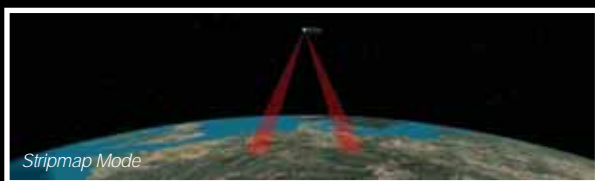
Highly flexible modes of operation



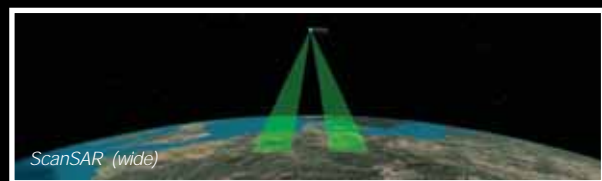
ScanSAR Mode



Maritime Mode



Stripmap Mode



ScanSAR (wide)

Modes	Typical Swath width	Spatial resolution	Incidence angle	Number of looks	Typical Ambiguity ratio	Typical Sensitivity
ScanSAR	100 km	20 m	16-30 degs	4	< -20dB	< -21dB
Maritime Surveillance	750 km	30 m	48-73 degs	1	< -25dB (Range)	N/A
Stripmap	15-20 km	6 m	16-31 degs	4	< -20dB	< -20dB
ScanSAR (wide)	140 km	30 m	14-32 degs	4	< -18dB	< -22dB

Baseline Operating Modes (based on 580km orbit)

Regular revisits

The mission is designed for sun synchronous or Equatorial orbits depending on the target area of interest. A single satellite using the fine resolution strip map mode can return to the same place anywhere on the globe twice a week. A constellation of three satellites can provide maritime surveillance of the same area every few hours.

Global NovaSAR-S average revisit times in days

Mode	Polar Orbit (SSO LTAN)		Equatorial Orbit (15°)	
	1 satellite	3 satellites	1 satellite	3 satellites
ScanSAR	4.0	1.4	1.2	0.4
Maritime	0.9	0.3	0.5	0.2
Stripmap	3.6	1.3	1.1	0.4
ScanSAR (w)	3.1	1.1	0.9	0.3

NovaSAR-S supports impressive imaging capacity

Not only does NovaSAR-S support flexible modes of operation but it also achieves an impressive volume of image data.

Minimum average daily imaging throughput per satellite	
Mode	10 ⁶ km ² per day
ScanSAR	1.1
Maritime	8.4
Stripmap	0.2
ScanSAR (w)	1.6

Multi-polarisation image products

The baseline payload can be operated in any of the four standard polarimetric configurations (HH, VV, HV or VH). Image products supported may contain single, dual, tri or quad polarimetric information.



Tri-polar



Single-polar



Zoomed-in 6m resolution with light aircraft detectable

NovaSAR-S Specification	
Imaging frequency band	S-band (3.1-3.3GHz)
No. of phase centres	18
Peak RF power	1.8kW
Design Lifetime	7 years
Mass	< 500kg
Lead time	24 months (KO to Flight Readiness Review)
Antenna	Microstrip patch phased array (3 x 1m)
Imaging polarisations	Single, dual, tri or quad polar - HH, HV, VH, VV (non-coherent)
Optimum orbit	580 km (SSO or low inclination Equatorial orbit)
Propulsion system	Xenon
Payload duty cycle	At least 2min per orbit (multiple images or single image >800km long)
Payload data memory	544GBytes
Downlink rate	500Mbps
TTC frequency band	S-band (2025-2110MHz, 2200-2290MHz)
Downlink frequency band	X-band (8.025-8.4GHz)

NovaSAR-S
represents an
evolutionary step
for SAR systems



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