



An Association for Retired Professional Engineers

NEWSLETTER December 2021



President's message

Hello everyone, and a warm welcome to the December Newsletter.

After many months of lockdown and uncertainty, I am pleased to say that our programme of talks has restarted once again.

The AGM was held in September and the same annual situation arose, asking for new blood to join the committee.

If you are 'almost there' but not quite ready to commit, please talk to me or anyone else from the committee. It is essential we get new points of view to keep things fresh and to hold interest.

On a particularly warm afternoon in early September, 23 members and guests visited the Tangmere Museum and were given a comprehensive tour by our friend Dudley Hooley.

Unfortunately, the next planned visit to the Ford Recycling plant had to be cancelled due to Covid requirements which were a step too far.

The two talks back at Field Place in our new home, The Pavilion, have been well attended and I feel things are slowly returning to some sort of normality.

Looking forward, there is the Christmas lunch at the Windsor Hotel in Worthing on December 9th and I am taking bookings for this, so please join us for a nice start to the festivities.

George Woollard

President

December 2021

PROGRAMME OF EVENTS January 2022 – April 2022

9th Dec	Thursday	Christmas Lunch at Windsor hotel, Worthing.
14th Dec	Tuesday	Talk – Alternatives to the high carbon internal combustion engine including, hydrogen, fuel cell and electric propulsion.
16th Dec	Thursday	Coffee – at Spotted Cow, Angmering
30th Dec	Thursday	Coffee – with Partners at Swallow's Return
11th Jan	Tuesday	Talk – History of weather forecasting
20th Jan	Thursday	Coffee – at Spotted Cow, Angmering
27th Jan	Thursday	Coffee – with Partners at Swallow's Return
8th Feb	Tuesday	Talk – Sun and space technology for solar observations
17th Feb	Thursday	Coffee – at Spotted Cow, Angmering
24th Feb	Thursday	Coffee – with Partners at Swallow's Return
8th Mar	Tuesday	Talk – Submarines through the ages. The history and technology of submarines.
17th Mar	Thursday	Coffee – at Spotted Cow, Angmering
31st Mar	Thursday	Coffee – with Partners at Swallow's Return
12th Apr	Tuesday	Talk - TBA
21st Apr	Thursday	Coffee – at Spotted Cow, Angmering
28th Apr	Thursday	Coffee – with Partners at Swallow's Return

All Talks and Meetings will commence at 2.30 pm and be held in the Pavilion, Field Place, Worthing unless another venue or time is indicated.

Timings for visits and outings will be as printed in the detailed description of the activity.

Coffee mornings commence at 10.30 am.

We apologise for only being able to publish a very short list of our forthcoming events. As you know we sometimes have to cancel/rearrange talks and visits, often at short notice. We do try and inform our members of late changes to our programme by email, but suggest that members should increasingly rely upon our website for up-to-date details of events.

Subscriptions

As members will know our financial year begins on 1 October and subscriptions for the new year are due then. Our use of Membermojo has made the collection of subs much timelier and, apart from a short glitch with Paypal now resolved, much easier for the Treasurer. There does remain a (very) small handful of payments not received which makes those members at risk of becoming deleted.

Website of the RCEA

Our website, www.rceasussex.org.uk carries the very latest information on all of our events.

New Members and Speakers for Talks

The RCEA needs new members and speakers to ensure that we can continue as a thriving organisation. Please think of appropriate people you know and encourage them to come along to our talks and hopefully join the RCEA.

We also need more speakers to give talks to us on Tuesday afternoons from September to March. We are aware that many members have the knowledge from their working careers to provide interesting talks. If you are willing to give a talk, please let us know. Speakers from outside organisations are increasingly harder to find and often seek payment for their services.

New Members

C. Lilly, PhD, DMS, C.Eng, FIET, FIOEE, MIOE. Mayfield, East Sussex
R.L.P. Sadler, C&G, I.Eng, MACE, MCQI. East Preston, West Sussex

RCEA Insurance

Members need to be aware that the insurance policy that the Association holds is solely for the protection for the assets and liabilities for the Association as an entity. The policy does not provide cover for personal injury or loss to individual members. Members attend the Association's events at their own risk; although under some circumstances there may be some cover from the insurance arrangements of the venue owner.

Newsletter Entries

If you would like to provide an article for inclusion in a future newsletter it would be very welcome as we are always looking for new material in addition to reports on previous talks and visits/outings. From feedback from our members, we know that the newsletter is particularly appreciated by those who are no longer able to get to our meetings and visits, so if you are able to contribute in this way it would be much appreciated. Articles should preferably be Microsoft Word documents, although we can usually convert both text and pictures (even photographs) into a suitable format. Accompanying pictures are best supplied as separate files which will be embedded within the text during editing.

Brief Detail – Talks, Outings and other activities January 2022 – March 2022

Talk

Tuesday 11th January – History of Weather Forecasting.

Ian Currie, Fellow Royal Meteorological Society, freelance weather consultant

Ian will look at early forecasting techniques, how people centuries ago would notice changes in the sky and wind direction as many worked out in the open on the land, forests or the sea. They were able to recognise the clouds responsible for bad weather.

His talk will then cover the advance of weather forecasting in the scientific age, the beginnings of the Meteorological Office and weather forecasts under Fitzroy who ended his days in Croydon.

He will then discuss other pioneers of meteorology such as James Glaisher, who also had associations with Surrey. He was famous for his dramatic balloon flights and for being a founder member of the Royal Meteorological Society.

Meteorology progressed during the twentieth century with an understanding of the upper atmosphere, jet streams and air masses, radar, satellites and the use of increasingly powerful computers capable of running complex simulations.

Talk

Tuesday 8th February – Sun and space technology for solar observations.

Chris Brockley-Blatt, Mullard Space Laboratory

Our speaker is the project manager for the Solar Wind Analyser, one of the in-situ instruments on board the Solar Orbiter which is currently observing the sun.

Solar Orbiter is attempting to address big questions in solar science to help us understand how our star creates and controls the giant bubble of plasma that surrounds the whole Solar System and influences the planets within it.

Launched in February 2020, Solar Orbiter carries six remote sensing instruments, or telescopes, that image the sun and its surroundings, and four in-situ instruments that measure properties of the environment around the spacecraft.

This presentation will outline the science behind Solar Orbiter, discuss the mission and the spacecraft, and describe in detail the Solar Wind Analyser and the engineering behind building a space science instrument.

Talk

Tuesday 8th March – Submarines through the ages. The history and technology of submarines.

Nigel Manger, RN Captain retired.

This talk will cover the early development of submarine through to the present day of nuclear submarines. It will be mainly related to the Royal Navy, but will reference those submarines of Germany, USA and Russia.

It will cover submarine conflict in WW1 and WW2 and the present expansion of the Russian fleet under president Putin.

Our speaker will also cover his experiences whilst serving in two diesel submarines and a Nuclear SSN as a Mechanical Engineer and on the Naval Staff in the MOD.

Talk

Tuesday 12th April

We are currently trying to arrange a talk for April. Details will be sent out to members when available by email.

Reports

Visit

Wednesday 21st July 2021 – Lawnmower Museum at Hassocks Garden Centre

This was the first time that we had been able to hold a meeting in person since the lockdowns began in Spring 2020, although we recently held a couple of talks on Zoom.

A total of 17 members attended with 2 guests, the meeting being held at the Museum of Gardening, which is located within the South Downs Garden Centre at Hassocks.

Our host, Clive Gravett (recently seen on Gardeners' World) gave us a presentation on the history of lawnmowers before we went to look around the various lawnmowers and other exhibits. Most attendees stayed for lunch where it was nice to meet up after so long.

The talk took place in the semi-covered area near the exhibits, rather than in an inside room, so ventilation was good.

Clive had put up a gazebo to try to shade the screen, but at one point the projector overheated. In spite of these preparations, it was difficult to see the screen properly, but Clive is very enthusiastic and knowledgeable, and we all enjoyed it.

All our attendance fees go to Clive's charity, the Budding Foundation, which runs the Museum and also provides support to young people who have been disadvantaged, with grants to help them with education and special equipment. The Foundation is named after Edwin Beard Budding, who invented the lawnmower in 1830.



The word lawn comes from the Old English *laune*, meaning a glade in the woods. The first recorded reference to what we would recognise as a lawn was by Pliny the Younger, who mentioned flat green spaces in his garden (after he'd finished describing the eruption of Vesuvius, and presumably at a different location).

The first lawnmowers were probably scythes, which required strength and skill to use. We learnt that professional workers used to carry a sharpening stone in a cow horn on their belts, together with a hammer and a small type of anvil, which they used to straighten and peen (or work harden) the edge of the blade if they hit a stone. (You didn't see that in the BBC1 Poldark!).



In the 1820s, Budding worked on machinery in woollen mills in Gloucestershire, and machines used to trim the cloth may have given him the idea for a machine to cut grass

He managed to get some finance, and registered the patent for his invention in 1830.

Production really began in 1832, when Ransome's were licensed to use the design.

Two people were needed to operate these mowers, which used gears to drive the cutting blades from the rotation of a heavy roller.

Another Budding invention was the adjustable spanner, using a screw or worm and rack.

Adjustable spanners were needed because nuts and bolts were cast, and not to standard dimensions, before sizes were standardised, and machining became more accurate. Prior to this, the size of spanners was set using wedges. He registered the invention in 1843, but didn't get a patent.

Budding also invented a Pepperbox pistol around 1830, with 5 chambers, which was the first repeating pistol, and maybe the original "revolver".

Samuel Colt patented his own design in America in 1836, and made a fortune.

Budding died in 1846.



Fascinating diversions from the subject, but returning to lawnmowers, Shanks of Scotland made the first horse-drawn mowers. The horses were fitted with leather boots to stop them cutting up the grass. These continued in use into the 20th century, and some are on display at the Museum. Camels were also used, e.g., in Central Park, New York, as their feet splay out and do less damage to the grass.

Early mowers were gear-driven, but in 1859, Thomas Green patented chain-driven mowers, which were more efficient. Ransome's were losing sales, and could not break Green's patent, so they produced mowers modified to look like chain-driven ones, but which had no chains (early example of marketing?).

In 1869, Follows and Bates designed a new mechanism, which drove the blades from the sidewheels, and dispensed with the heavy roller.

The first steam and electric powered mowers appeared in the 1890s. In 1895, a Master at Repton College called Stephenson-Peach made the first petrol-driven mower. Later, he was involved in making the first Morgan 3-wheeler cars.

After the First World War, ATCO Stanley made the first mass-produced petrol-driven mowers. These cost 75 guineas, which is the equivalent of about £4,000 today, so only for rich people: presumably less-wealthy people didn't have lawns anyway.

The first rotary mower was patented by James Cockburn in 1932, and these improved the collection of grass cuttings. Clive mentioned that the tip of the blade needs to move at over 172mph to cut grass, rather than flatten it. The speed threshold is subject to the type and length of grass and how wet it is.

The last major development was the hover mower in 1964, which has become the most popular type. There were several stories about why Flymo mowers are orange, but the basic theme is that at that time we enjoyed orange furniture, orange carpets – everything except orange grass.

Clive concluded with an update on the museum, which is moving up to a mezzanine area, and on the Budding Foundation charity, which is doing some very good work: for example, they have given a grant to a student at Plumpton Agricultural college who could not afford to complete his course as the family had been hit by the effects of Covid.



Several members bought copies of Clive's book "Two Men Went to Mow", which is also on sale at the museum.

All profits from our visit, and from book sales also go to the charity.

Following the talk members were free to visit the museum of lawnmowers and to enjoy the lovely warm weather on this visit.

Chris Coates

Visit

Thursday 9th September 2021 - Tangmere Military Aviation Museum

This visit followed the very popular talk on Operation Deadstick given by Dudley Hooley to us on 18th May this year via Zoom, and was a much welcome opportunity to meet together and look at some of the aircraft mentioned by Dudley in his talk.

Most of our visitors made good use of the Cockpit café on the site to take lunch before the tour itself. It was heartening to note how many visitors there were to Tangmere this day, necessitating opening the overflow car park.

Due to the visitor numbers, we were separated into a number of smaller groups for the guided tours.

The following pictures capture the progress of the tours, often addressed by Dudley himself, and inevitably culminating in a group photograph in front of a Hunter when we all came together at the end of a most enjoyable visit.



Talk and AGM

Tuesday 21st September 2021 – London Curiosities and Oddities

Sally Botwright

Our speaker, Sally Botwright, is a London Blue Badge guide. Sally explained that for the last 18 months she has been unable to provide her usual coach or walking tours in London due to the pandemic, but has fortunately been able to give talks on Zoom in the meantime. She welcomed the first opportunity to give one of her talks to a live audience for a very long time.

Whilst London has a large number of attractions, due principally to its long history, the talk today would concentrate upon aspects of London which were probably less well known, and, without an experienced London guide, probably missed by the London tourist.



She began by showing pictures of the Hyde Park pet cemetery at Lancaster Gate (shown left), which is now full, largely with dogs. Whilst in the Hyde Park area, the stables on Rotten Row shown right are worth a visit.



Staying in Hyde Park for a moment, one of London's most spectacular sights is the Albert Memorial which is directly north of the Royal Albert Hall in Kensington gardens.

It was commissioned by Queen Victoria in memory of her husband, Albert, who died in 1861.

It stands 176 feet tall.





The memorial was designed by the architect George Albert Scott and contains a wealth of statues and carvings as shown.

Surrounding the base of the memorial are 197 famous figures (left), in addition to some very ornate carvings at the top(right).



Sally went on to talk about Fleet Street and Hodge the cat which was owned by Samuel Johnson, before moving on to Oxford Street, which doubtless all our readers will have heard of and have probably passed by the building at 105-109 Oxford Street, shown below left, without casting a glance skywards to the roof of the building.



Atop this building are three large carvings of beavers, one of which is shown right. The beavers have looked down on Oxford Street for over 120 years, and originate from the time when this building housed the hat maker, Henry Heath, who used fur from beavers, otters, musk rats, rabbits and hares in the manufacture of top hats.



Although the hat maker Henry Heath has long gone, you can still see the shop sign if you visit the rear of this building in Berwick Street.



Before moving on to the square mile, Sally talked about the Royal Exchange, which handled the trading of commodities and the influence of the Gresham family whose emblem is the grasshopper.

Within the square mile, Cornhill, or more specifically 32, Cornhill, previously the Cornhill Insurance Company, is worth a visit to see its ornate wooden doors carved by William Gilbert, depicting inter alia two of the Bronte sisters accompanied by William Thackeray when visiting the publishers Smith Elder.

One of the oddities of Cornhill are the Devils, shown left, at 54 and 55 Cornhill. It is thought that these were added to the building by the architect in order to annoy the vicar of the nearby St Peter's church who had objected to the architect's plans on the grounds that they intruded onto church land.



On the more macabre side, Sally introduced us to the old operating theatre (left) situated in the attic of St Thomas's church, which is thought to be the oldest such operating theatre in the world, and the necropolis railway (right) which was in Westminster Bridge Road. By about 1850, London's cemeteries were pretty full, so the necropolis railway was built to take corpses from London to Brookwood cemetery in Surrey. It was unofficially referred to as the 'Stiff's railway'.



In her talk, our speaker went on to take us through many more of London's curiosities and oddities, some of which are illustrated overpage.



Hyde Park arch



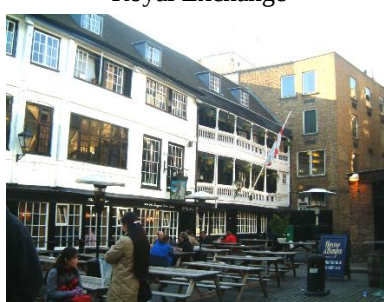
Royal Exchange



Trafalgar Square police station



Leadenhall market



George Inn



The Clink

In this short article it has not been possible to fully cover the extensive number of London's sights that Sally presented in her talk, but interested readers can visit Sally's website at www.sallybotwright.co.uk where they can purchase Sally's illustrated book on this particular subject.

Talk

Tuesday 12th October 2021 – Railway Rolling Stock – a generation of change

Jeff Ward

Jeff started his talk by telling us that he would be concentrating primarily upon Eurostar which is the passenger carrying service which links the UK with the continent via the channel tunnel, or Eurotunnel, which also carries vehicles and their passengers using the Shuttle and international freight trains. The two Eurostar illustrations below show on the left, the original class 373 trains, and on the right the current class 374.



Eurotunnel itself opened in 1994 following several much earlier plans to link the UK with the continent dating back to 1802.

Traction Fundamentals

As $\text{Power} = \text{Force (tractive effort)} * \text{Velocity (speed)}$, the power requirements for a train depend upon the duty that the train is designed to undertake: -

For Freight - lower speeds, high tractive effort

For Commuter – medium speeds, higher acceleration

For Inter City – high speed, less critical acceleration

For High speed trains – very high speeds, significant air resistance and lower limits on axle weight

Traction motor developments from the early 1980s

Initially all traction motors were DC, but then came brief developments of slotless DC motors, tubular axle induction motors and asynchronous 3 phase motors. Switched reluctance motors were looked at but not developed. From the late '80s, 3 phase motor application have predominated.

Traction control developments from the early 1980s

Starting from camshaft resistance control, the industry moved on to tap changer transformer and silicon rectifiers, diesel engine management and field weakening and then to phase angle control rectifiers. Following that we had chopper control, thyristor inverters and now Insulating Gate Bipolar (IGBT) transistor inverters as the technology has evolved.

Eurostar class 373

This was the first Eurostar train. The specification and contract were approved in 1989, just before the 'breakthrough' in the tunnel in 1990. The Eurostar terminal at Waterloo opened in 1993 at the same time as the North Pole depot in London, and the commercial service began on 14th November 1994.

The design of the train was loosely based upon the French TGV-Atlantique with significant modifications to allow for the infrastructure constraints, and ran on a 750v DC supply. It was once described as getting a quart into a pint pot, as it had to accommodate 7 power system selections (later 8 with 1500v DC), 5 signalling systems (later 7) and 2 radio systems (later 3). All systems had to be capable of being switched on the move!

This above complexity led to what is now considered an overambitious specification and difficult start, but is now a success story due to the steady engineering improvements.

Initially 34 class 373 'Three Capitals' trains were ordered, and finally 31 such sets were delivered along with 7 class 373/2 for north of London service.



Regulatory Authorities

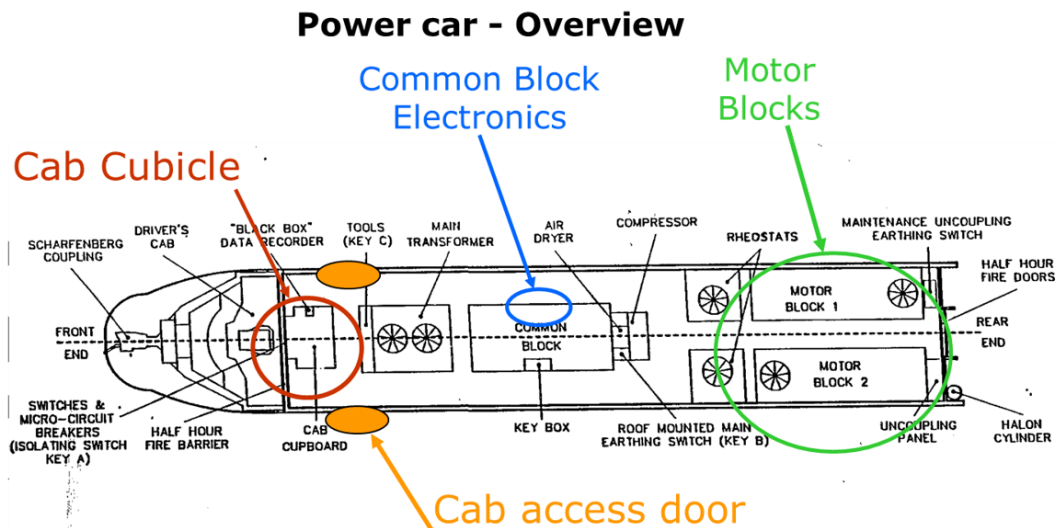
• UK	ORR	Office of Rail and Road
• France	EPSF	Établissement Public de Sécurité Ferroviaire
• Belgium	SSICF	Service de Sécurité et Interopérabilité des Chemins de Fer
• Channel	CTSA/	Channel Tunnel Safety Authority
• Tunnel	IGC	Intergovernmental Commission

Jeff discussed many of the challenges that such a complex, multinational project, had to meet, all handled by the three railways with a small engineering team within Eurostar group, but with responsibility still held by 3 railways. A great deal of the work was handled by sub committees, Maintenance documentation by SCDM, technical evolution by SCET, Optimisation of Eurostar by GPOE and Reliability improvement by GRAFE. A total of 5 regulatory authorities oversaw the project as listed opposite. The team also had to work with 3 depots, Le Landy the TGV depot in Paris, Forest, the TGV depot in Brussels, and North Pole International (now Temple Mills) in London. Eurostar UK Ltd became Eurostar International Ltd in September 2010 taking responsibility for the service.

Reliability

Although overall reliability has been steadily improved, the most serious problem occurred on 18th December 2009 when a sudden cold spell in northern France left 5 trains stranded in the tunnel. The disruption lasted for several days at this critical time before Christmas.

The picture opposite shows the layout of the power car. The combination of the very cold conditions and heavy snowfalls in France led to a number of failures in the control and traction equipment.



The engineering team quickly identified key areas for closed air management to keep snow out and achieve warmer winter temperatures for technical equipment without compromising summer operation. This achieved cleaner electronics environments and kept critical equipment free of winter condensation.

Since this major problem, reliability in 2014 hit 12.4 incidents per million km, which translates to 50,000 miles per technical incident.

In 2009 design work began in conjunction with the design house Pininfarina, to give the class 373 trains a mid-life 'facelift' and rebuild work commenced in September 2012.

Eurostar Class 374

This class of train has now replaced the un-refurbished class 373. The project had a significant number of objectives to achieve

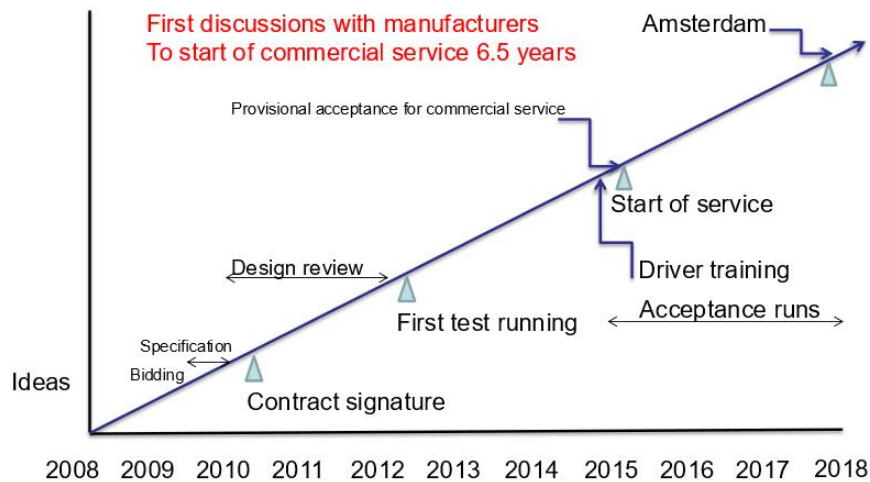
following the learning experience of operating the class 373:

- No requirement to run on classical UK lines
- Higher passenger capacity
- Lower maintenance costs
- Increased reliability
- More attractive train
- More efficient train

Jeff then illustrated his talk by sharing with us the following slides which illustrate how far the project has benefitted from a new approach to the entire procurement process.



Train procurement



64

The basic design of class 374 came from the Siemens Velaro which was already in service in a number of countries. Siemens became the preferred bidder following a competition with Alstom, and all construction work took place at Erlangen in Germany. Our last picture shows the class 374 Eurostar.



Our thanks to Jeff for giving us a fascinating insight into one of the current engineering achievements which many of us have used whilst travelling to Europe without any detailed knowledge as to how complex this task and that of constructing the tunnel were.

Talk

Tuesday 9th November - NovaSAR - An affordable Synthetic Aperture Radar (SAR) Satellite built in the UK

Martin Cohen, Airbus

We had been trying to arrange this talk since 2018 and only now have we been able to bring it to our members in person.

Project objectives

The main objectives of the project were to maximise performance to cost ratio, realise a truly affordable SAR payload (and satellite) with 'good' capability and to open up the SAR image_export market. These objectives would provide an earth observation satellite at much lower cost than existing SARl satellites, whilst at the same time offering potential customers resolution sufficient to cover a broad range of tasks.

It has been possible to accomplish these objectives primarily due to the availability of Gallium Nitride semiconductors which have higher frequency, power and operating temperature capabilities than those Gallium Arsenide devices which they replace.

Savings were also achieved by using a relatively small local team of about 10 persons rather than the large multi-company teams traditionally used in the more sensitive and capable up market versions. This said, they are still able to fulfil a market for many requirements not requiring such sophistication.

The project was initially funded by Airbus R&D and the UK Space Agency (UKSA).

Radar details

The radar operates in the S-band (3.2 Ghz) giving a resolution of 6m with a swath width of 15-20 km.

As a useful reference the diagram below shows the various frequency bands up to Ka band (around 30 GHz).

UHF	L Band	S Band	C Band	X Band	Ku Band	Ka Band
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300 Mhz 1.0 GHz 2.0 GHz 4.0 GHz 8.0 GHz 12.0 GHz 18.0 GHz 30.0 GHz

All frequencies are approximate and there is a K Band between 18GHZ and 26GHZ left out for clarity. The higher the operating frequency, the higher the allowable bandwidth. Both of these parameters are internationally controlled.

Martin began his talk by describing the fundamentals of synthetic aperture radar; in particular how you can create an image of the ground whilst travelling some 580km above it.

Fortunately, radar can 'see' through the clouds and is not dependent upon light illumination, so that acceptable images can still be achieved day or night

He then discussed the two principal modes of operation of a travelling SAR, Stripmap mode and ScanSAR mode.

The conventional SAR strip mapping mode assumes a fixed pointing direction of the radar antenna broadside to the platform track. A strip map is an image formed in width by the swath of the SAR and follows the length contour of the flight line of the platform itself.

In ScanSAR mode, the satellite electronically steers the beam between sub-swaths. By periodically sweeping the antenna beam in this way, ScanSAR can obtain a wide swath at the expense of sacrificing azimuth resolution.

He then went on to discuss some detailed aspects of the radar itself, and had brought along some hardware components to pass around, as few of us had seen what actually went into a satellite before.

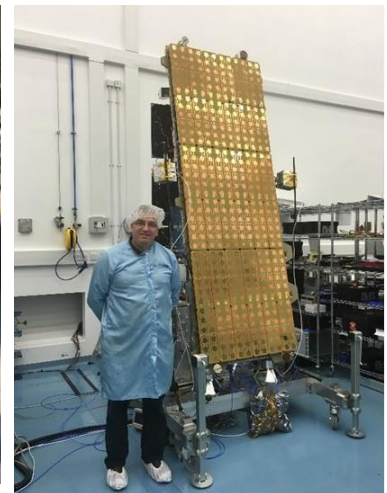
This would have been impossible if we had still been having our meetings on Zoom!

In the foreground we see one of the transmit/receive antennae modules, and in the background are some of the electronic modules that drive the antenna.

The module in the centre behind the antenna is gold plated, so Martin had to keep an eye on that one as it was passed around!



The completed radar has 18 such antenna and is shown in the two pictures below (Martin is the human reference standing by the radar in the right-hand picture) which shows the completed SAR, which was christened ‘The Cheese Grater’ by the team as it resembled the building of the same name at 122 Leadenhall Street in London.



Inevitably with a complex project such as NovaSAR, there were a number of unexpected issues to resolve as development proceeded, and Martin discussed some of these including some early component failures during the rigorous environmental tests, and the need to build into the design some elements of redundancy for critical sections, as repair in orbit was not an option. So far NovaSAR has performed as designed without having to switch over to the built-in redundant sections. NovaSAR has a design service life of 7 years.

Having discussed the heart of NovaSar, the radar, Martin then gave us an insight into the rest of the spacecraft major components

In spacecraft terms, the radar is referred to as the payload, which is the part of the spacecraft built to achieve the mission’s objective. In most projects, as here, it is a separately constructed module which is mechanically and electrically integrated to the platform in the final stages of construction. It will have been thoroughly tested and verified before delivery to the spacecraft integrator.

The platform, which carries the payload, contains the following subsystems:

Power

Power can be regulated or unregulated depending on payload requirements and cost. Solar Arrays and batteries normally provide the source of the power, although nuclear sources can be used in extreme circumstances

Attitude and Orbit Control (AOCS)

This consists of momentum wheels, thrusters and attitude sensors plus associated controls. In the instances where chemical thrusters are used there will also be a tank for propellant, normally hydrazine.

Telemetry and Command (TT&C)

There will be a receiver on board to accept and decipher ground commands for controlling the spacecraft. There is a distribution system to ensure that each command reaches its intended destination. A telemetry system collects data from all the sensors on board. It operates in a Time Division Multiple Access mode (TDMA) transmitting the full format to the ground. This ensures that all subsystems are operating correctly and that all commands have been acted upon.

Project Partners

In order to keep each partners contribution as low as possible Airbus (which includes SSTL, a subsidiary) provided the spacecraft free of charge. The Indian Space Research Organisation (ISRO) provided the launch vehicle and launch free of charge.

The UK Space Organisation has a 15% share as they supplied some of the funding.

Other agencies such as Harwell, CSIRO (Australia) and DOST-ASTI (Philippines) provide image processing software and satellite scheduling to fulfil customer requirements.

Project timetable

The project received UK government financial support in November 2011, the completed radar was delivered to SSTL in July 2015, shipped to India in August 2018 and finally launched into space on 18/9/2020.

Although this was the UK's first such satellite, several other such satellites were launched before this one and many more subsequently.

Launch



The satellite was launched from the Satish Dhawan Space Centre, Sriharikota in India on 18/9/2020. See left.

The rocket in fact also carried another satellite in addition to NovaSAR.

The pictures overpage show the PSLV-C42 launch vehicle, and below this, Mission Control Centre some 3.5 km from the launch pad.

One interesting point about the launch vehicle is that it is assembled in the tall building shown in the background of the righthand side picture and upon completion the building itself is moved out of the way leaving the launch vehicle on its pad in situ. A very elegant solution!



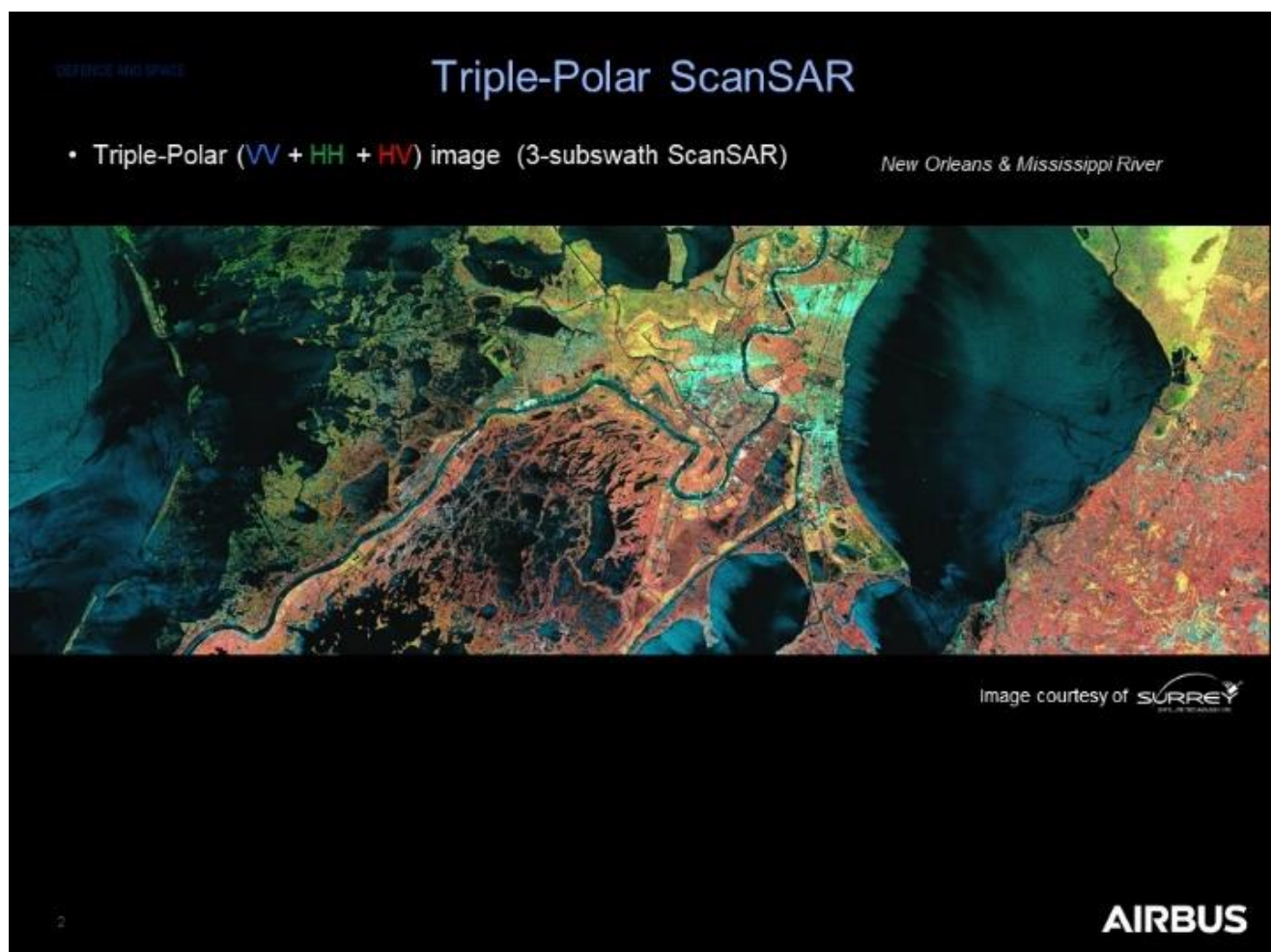
Shriharikota is an island just off the coast of southern India and the preferred launch path would take the space vehicle over nearby Sri Lanka. Unfortunately, Sri Lanka has banned overflying, necessitating having to insert a 'dog leg' in the flight envelope, resulting in additional fuel burn and hence reduced payload.

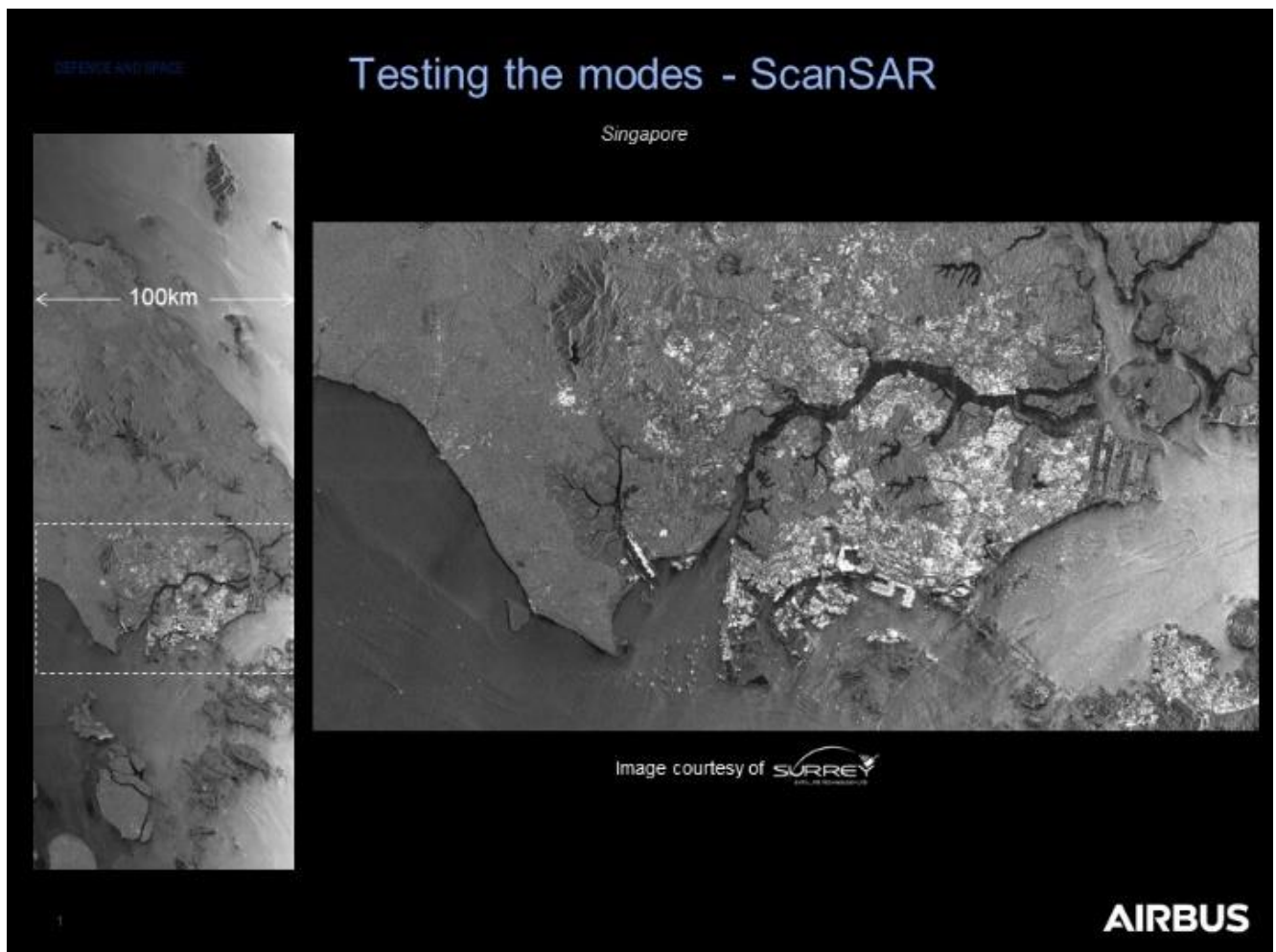
Satellite Operation

The satellite continuously orbits the earth at an altitude of 580km, completing some 16 orbits each day. Daily operation is controlled by SSTL in Guildford with whom customers book observation slots. These have to be booked some time ahead as the radar can only operate for about 5 minutes each hour due to power limitations, and obviously the entire satellite must be 'steered' to the customers required observation site well ahead of time.

Typical applications include flood monitoring, agricultural crop assessment, forest monitoring (temperate and rain forest), land use mapping, disaster management and maritime applications (e.g., ship detection and oil spill monitoring).

Martin showed a number of the many images taken by NovaSAR, one below and one overpage.





New Developments

Since this project started, technology has moved on and Airbus are now working on a successor to NovaSAR which will operate in the X-band allowing a higher bandwidth of 1200Mhz to be used. By doing this a higher resolution of 50cms should be attainable. This would further widen the potential range of applications for these small orbiting satellites.

Martin concluded his talk by showing us a recent image of West Sussex where members will be easily able to recognise the Isle of Wight and Selsey Bill. Our thanks go to Martin for such a detailed and interesting presentation and to Airbus and Surrey Satellite Technology for the excellent illustrations that accompanied the presentation.



D.B. Thomas

End of Newsletter