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# ASRC News

QUARTERLY NEWSLETTER OF THE AVIATION SERVICES RESEARCH CENTRE


Embraer EVE Concept Development

## In this big issue



## Capacity Crunch Post Pandemic

As the world starts to come out of the pandemic, the pent-up demand in Europe, America and Australia has caught airports and airlines off guard. Some thousands of staff were laid off during COVID-19 and many of them have now moved on to other industries. They may be reluctant to return due to pay and working conditions. These staff shortages threaten aviation recovery at a critical time for the industry. Fortunately OEM's and MRO's retained as many of their key staff as possible during this period, as they were acutely aware of the potential challenges in replacing experienced individuals. Hence they remain ready to meet the return to work needed to reboot the industry.

As always at the ASRC, we have continued to try to nurture local talent by bringing new STEM engineers into the industry with a further two new interns joining us in June, supporting industrial product design and system testing for the Radome Assessment and Transmission Test System. This helps ensure that a steady stream of engineers are introduced into the aviation sector here in Hong Kong. Unfortunately like all organisations, we also lost key staff, so also in June we bid farewell to Miss Ada Poon, a long serving member of staff in the role of Assistant Executive Officer. We wish her and her family good luck in their new life adventure in the UK.

## Quality Policy at the ASRC

Cost and time always have been at the centre of the attention from the ASRC partners. As the ASRC has now been the established leading research centre in the aviation field in Hong Kong for a decade, the need to emphasize on quality, accuracy and reliability cannot be undermined. Although the ASRC always follows requirements and guidelines from the Hong Kong Polytechnic University, the very specific projects and duties undertaken by the ASRC require an adapted Quality Management System (QMS), similarly to any company in the aviation or manufacturing sectors.


The ASRC QMS, which was prepared and reviewed during the first semester of 2022, has gone live on July 1st. It is based on the ISO 9001 requirements with some additional aerospace and manufacturing standards. It is currently composed of 30 documents ranging from the ASRC policies at the top to the procedures and quality records at the bottom. These documents were not created to establish new rules, but rather to describe the work as it is already done by our Project Leads and staff, defining a shared standard that everybody can refer to. It is the way we want to go to ensure process management and to move towards producing more repeatable, accurate output with full control.

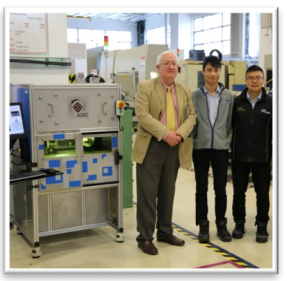
With the ASRC QMS now live, our research centre makes full use of this framework to continue delivering projects and products on time, on cost and on quality to our members and customers.

## Implementation Projects

Upon completion of a funded research project it is often the case that a member organization requests that we continue the research into a development and implementation phase. In many occasions we have continued and with funding from the member delivered a working solution to the site in question.


Component Recording Booth

At present we have robotic, automation and IT solutions in HAECO and HAESL, whilst we are presently implementing automation solutions in HAECO JinJiang and HAECO Composite Services where we hope to install our first Radome Test Rig. We are also in discussion with HAECO LGS to improve some of their practices and are helping them by conducting shadow tasks in Hong Kong.


Laser Part Marker

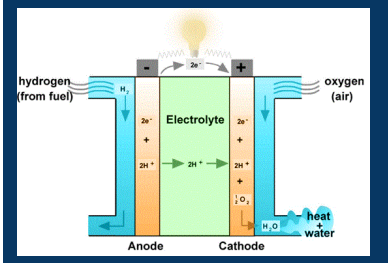
Sometimes an implementation project will arise our of blue sky discussions with our members and we have even produced some manufactured parts for our partners in Boeing (BRT, Beijing).

## Green Corner -
## Hydrogen power

As human activity threatens to destroy civilization with the runaway greenhouse effect and mass migration precipitated by related crop failure further exacerbates the issue, we look, in this column at measures that we could take and will perhaps one day actually take. - Hydrogen fuel Cells

All transfer and use of energy until 1945 (with the use of nuclear power) was by combustion, primarily of hydrocarbon materials such as coal, oil and gas. This energy generation from the industrial revolution onwards has created a climate crisis which must be addressed.

An alternative method of releasing energy without combustion and the creation of greenhouse gasses is to make use of proton exchange membranes and Hydrogen gas. The so called 'Hydrogen Fuel Cell' can be rather efficient with 45% energy delivered to the reciprocating component.




The principle of the fuel cell was expounded in 1838 but not until 1932 was a practical fuel cell produced. They have been used primarily by the space agencies for power on space stations and flights to the planets although now more terrestrial applications are planned.

The principle of operation is for the hydrogen to be ionised into electron and proton at the anode by a platinum catalyst, the electron moves to the cathode producing direct current electricity and the protons are recombined with oxygen and electrons to form water. There is no CO2 produced in the process and the only exhaust is water. Issues still exist regarding the production and storage of hydrogen but there are promising advances being made each day. H2 powered flight may not be far away.

*Mr. Mannion is Lead of the Data, Materials and Instrumentation Stream of the ASRC*

# Project Descriptions

## ITC funded Open source projects underway in the ASRC

### Machining Distortion Minimisation

Stress and distortion in aerostructure parts costs the aviation industry approx. US$1bn per annum due to corrective action, scrap parts, or later delivery of parts. Therefore, any reduction in this area can give huge benefits to the OEM and its supply chain. This project is now in its final phase, where it is becoming very apparent that distortion can be predicted, and therefore prevented. Over 200 parts from 5 different material suppliers have been machined on high-speed and high-performance machining centres during the project, with residual stress analysis undertaken pre and post machining to determine the levels of stress in the material. Where FEM analysis of machining methodology has been undertaken to simulate the machining strategies and predict stress fields and distortion. In-process monitoring including displacement sensors, vibration sensors, strain gauges, temperature monitoring, spindle monitoring, in process probing, and coolant monitoring have been conducted and managed within a Digital Twin. With CMM inspection of all machined components for geometric verification at the end of the process plus ultrasonic thickness gauging, and conductivity tests. All data collected is analysed and fed into the internally developed AI system (machAI) to support distortion prediction and machining method analysis. With data correlation and regression testing ongoing to help support an industrial standard solution.

### Radome Assessment and Transmission Test System

The Radome is a critical, yet passive, component on the airframe. It protects the weather radar and is optimized to have an aerodynamic profile. The transmission at the radar frequency of 9.5 GHz through the radome should be over 95% as this is the standard for Doppler radar which is fast becoming the norm on aircraft and is used to detect wind shear and clear air turbulence.
Should the Radome become damaged, and due to its location this is rather common, the radome is scarf repaired and tested to ensure that the transmission is at the same level as before. The two options for this are to use a large anechoic chamber and test the radome with a weather radar and a radar signal some 50 metres or more away. The second method, which is not the same as certification, is to measure the decibel loss on a point to point basis.
We will use a pitch and catch method to test the radome at each point and produce a map of the decibel loss over the entire radome. This will be overlaid on a map of the subsurface health of the radome obtained by flash thermography using a 8 to 12 micrometre thermal camera translated over the entire component.

### Cold Metal Spray Deposition

Firing metallic, ceramic, or composite alloyed powders in the supersonic speed regime of 600 - 1200 m/s at 800˚C in an open environment as a depositional repair process may sound like science fiction, but cold spray is very much science fact, that will bring benefits to aviation component repair applications.
The dynamic work-hardening process involved enables large areas to be bonded rapidly with purely mechanical clean adhesion; heat produced from the powder and workpiece during collision ensures plastic deformation is retained in the zone where it is created, resulting in negligible residual stress, with initial physical and chemical material properties retained.

The challenge however remains in maximizing the utilization of heat generated upon the impact of powder governed by the physics of adiabatic shear instability. R&D work at the Centre continues to be carried out to identify the critical particle velocity tolerance window and angle of attack for successful repairs on selected components in relation to spray particles of interest. Testing on representative specimens for aero engine, landing gear, and structure repair is currently being conducted following a series of ASTM/ISO standards to ensure the results meet recognised global standards, enabling successful fruition of the project, and the industrialisation of a Cold Spray repair solution for aircraft components for the ASRC Members.

New Group photograph, ASRC - JUNE 2022

## Aviation Classics — the Boeing 727

The Boeing 727 was the only 'tri-jet' produced by the Boeing Company and featured the classic T-tail configuration with a swept S shape intake for the centre mounted third engine. This placed a number of limitations on the aircraft in terms of upgrading the engine packages as the aircraft got older but allowed for its most iconic feature - integrated rear access steps. This was included as a feature as the jet would possibly visit airfields that didn't have air bridges. The unexpected bonus from this was the aircraft proved popular as an executive jet for VIPs.


Iconic Rear Stair access/ egress on early B727s

On one occasion a hijacker exited the aircraft from the rear stairs with ransom money and a parachute. It is not know if the fellow survived to enjoy his new wealth. The stair access was blocked from opening in flight after this event. In addition to being a favorite of the VIPs and wealthy the 727 was a significant workhorse for the short haul market and was only eclipsed by the seemingly unbeatable 737 and the A320 family.


A B727 - 200 with BA livery

The 727 was originally to be a shared venture with the de Havilland Tristar design team but in the end Boeing went in a different direction over requirements that suited the American Market such as seating and short runways.

## ASRC Equipment - Vector Network Analyser

The Vector Network Analyser (VNA) that is in use at the ASRC is manufactured by Rhode and Schwarz. It is a two channel machine that can generate and receive (analyse) signals from 100 KHz to 20 GHz. The analyser uses a windows based OS which offers a high degree of flexibility in display and signal control. Power output is in the low milliwatt range and offers no hazard to the human operator.

R&S VNA

A vector network analyzer is used to make measurements on complete devices that are not possible with other RF measuring equipment. A VNA makes transmission measurements (transmission coefficient, insertion loss, gain), reflection measurements (reflection coefficient, VSWR, return loss), impedance measurements and the S parameters (scattering parameters) S11, S12, S21, S22 resulting from the influence of a device on a signal. It provides calibrated stimulus signals to the RF network or device under test and measures with receivers the response as a vector over frequency with phase and amplitude information.


## Membership Benefits of the ASRC

Companies who join the ASRC as members should have a primary involvement in Aircraft Maintenance, Repair and Overhaul or should benefit from involvement and investment in technologies which may spin off from this field of research and development.

If you feel you are in one of these categories and would like more information on benefits and details on how to join, have a look at the website at www.asrc.hk or contact our CEO, Mr Robert Voyle (robert.voyle@polyu.edu.hk).

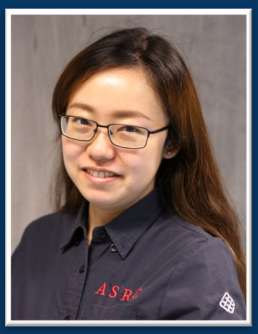
In principle there are different levels of membership with different levels of access to research in the ASRC. Almost certainly there is a membership level that is a good match for your company.

## Asian Airline Profile

HK express

HK Express is the low budget carrier for Hong Kong passenger flights and was formed in 2004 by Macao casino magnet, Stanley Ho. Its fleet consists of 23 Airbus A320 aircraft and they operate to a range of Asian destinations, predominately to secondary cities in Japan, Taiwan, Korea, Cambodia and Vietnam.

The airline was bought over completely by Cathay Pacific in 2019 and is managed from Cathay City. It still offers cut price fares direct to interesting Asian destinations skipping the need for connecting internal flights; for example to Siem Reap, Incheon, Da Nang and Nha-Trang. Following from the take over by Cathay, all flight operations to China were handed to Cathay Pacific and they concentrated on other regional destinations. The COVID pandemic has seriously affected them in addition to Cathay Pacific.



## Staff Profile: Anita XIN

**Dr Anita XIN is a Team Leader in the DMI Stream at the ASRC and a Principal Research Fellow**

Dr Anita Ying XIN is Principal Research Fellow in the Aviation Service Research Center (ASRC) of The Hong Kong Polytechnic University (HK PolyU). She is a Team Leader in the Data, Materials and Instrumentation Innovation stream of the ASRC. She obtained her PhD degree from The PolyU in 2016. Her research interests include advanced manufacturing, on machine probing, machine vision, and 3D geometric reconstruction of complex surfaces. She has been involved in projects such as Aircraft Damage Inspection, Automated Scarfing and NDI and Reverse Engineering of MRO Fixtures. Today she is working on Radar field evolution in Radome testing. She was one of the first staff to join the ASRC, which has become the leading laboratory in the aviation field in HK. The research projects she was involved in mainly focus on the non-destructive testing of aerospace components to enable the MRO industry to transition to industry 4.0.

# Activities

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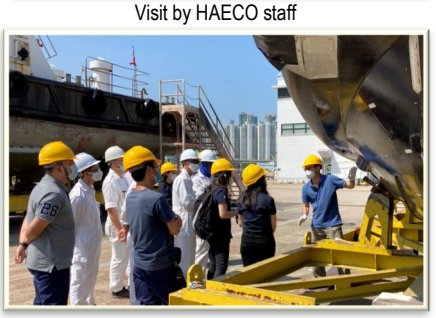
| **28 APR** | Visit by HAECO. TSC Meeting and radome testing discussion |
| **29 APR** | Visit by HAECO Engineers |
| **3 MAY** | Visit by MTRC staff and High Speed train department |
| **4 MAY** | Project evaluation at Marine Police / Government Docks |
| **11 MAY** | Project evaluation with HAESL by Senior Staff (Blisk discussions) |
| **25 MAY** | Radome Test Rig live walk round for Boeing company |
| **8 JUN** | Demonstration of Radar tech for HAECO (CLK and Jinjiang) |
| **9 JUN** | Cold Spray technical discussion with Boeing experts |
| **10 Jun** | Presentation on RATTS progress via ‘Zoom’ with ITC |
| **10 JUN** | Visit by Metrojet |
| **17 JUN** | Visit by Greater Bay Airlines |

Visit by HAECO staff



Visit to Hong Kong Government Dockyard

Metrojet visit the ASRC

High Speed Rail and the MTRC at the ASRC

## The ASRC on Social Media

ASRC maintains four active social media accounts, namely ‘Facebook’, ‘LinkedIn’, ‘YouTube’ and ‘Instagram’. These are updated from time to time after visits and special events in the centre. Needless to say this has been less frequent over the past couple of years. Despite this we try to keep information flowing on these platforms to allow followers to keep up with our activities.



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