



AMRC /
ADVANCED MANUFACTURING
RESEARCH CENTRE



The
University
Of
Sheffield.

2nd CIRP Conference on Composite Material Parts Manufacturing

10th & 11th October 2019

Programme

The University of Sheffield
Advanced Manufacturing Research Centre
Sheffield, UK





Chair

Dr Kevin Kerrigan
Advanced Manufacturing Research Centre
The University of Sheffield



Co-chair

Prof. Paul Mativenga
The University of Manchester



Co-chair

Prof. Keith Ridgway
Advanced Manufacturing Research Centre
The University of Sheffield

Scientific Committee

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Dr Hassan El-Dessouky, UK
Prof. Paul Mativenga, UK

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Prof. Vadim Silberschmidt, UK
Prof. John Summerscales, UK
Prof. Ramesh Tatreja, USA
Prof. Roberto Teti, Italy
Prof. Konrad Wegener, Switzerland

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2nd CIRP Conference

on Composite Material Parts Manufacturing

10th & 11th October 2019

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AMRC
ADVANCED MANUFACTURING
RESEARCH CENTRE



This conference offers a tremendous opportunity for experts spanning from academia to industry in the field of composite material parts manufacturing to present and discuss their findings on a very high level, stimulating and supporting the knowledge in this field.

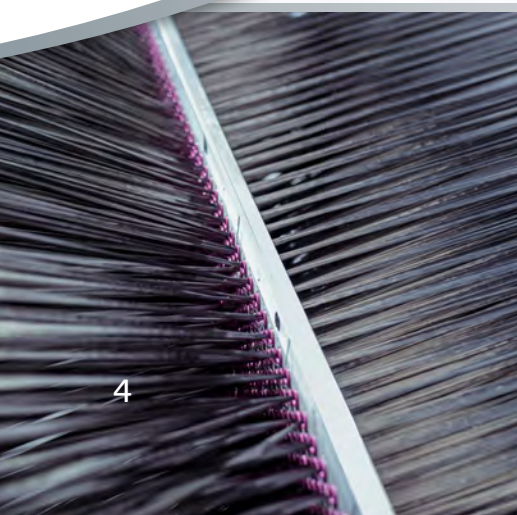
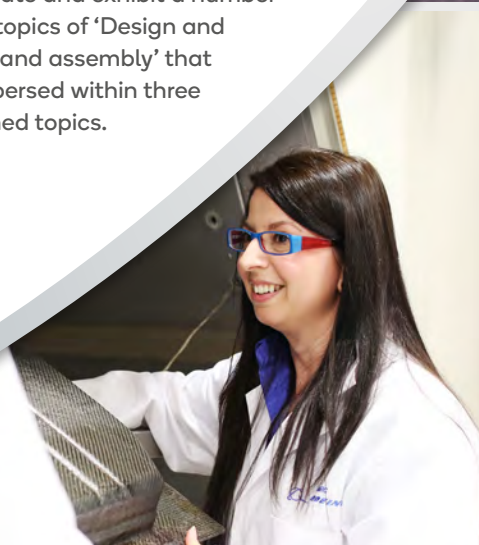
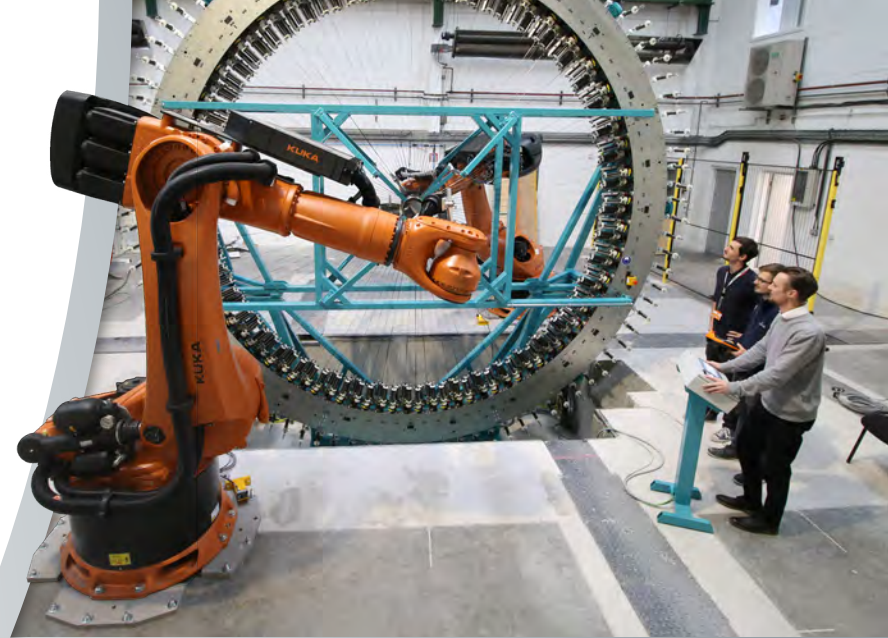
The 2nd CIRP CCMPM follows on from the success of the 1st conference of its kind, which was founded in 2017 by our esteemed colleagues, Professor Jürgen Fleischer and Professor Roberto Teti. The need for such a conference was identified during a namesake CIRP Collaborative Working Group (CWG). Since the formation of these CWG meetings, the topics “Design and Lifecycle”, “Part Generation” and “Part Finishing and Assembly” were each discussed in every meeting, and always with a focus on industrial use-cases. The aim of the conference is to bring together and share novel production research, technologies and solutions to the global composite manufacturing community. This is underpinned by an international scientific committee of highly esteemed researchers of composite material parts manufacturing and other related research areas.

The plan during this conference is to demonstrate and exhibit a number of new and innovative technologies under the topics of ‘Design and Lifecycle’, ‘Part Generation’ and ‘Part finishing and assembly’ that deliver real world benefits. These will be interspersed within three parallel sessions concerning the aforementioned topics.

Welcome to the AMRC.

On behalf of the organising committee.

Dr Kevin Kerrigan,
Conference Chair.



Keynote speaker



Dr. Ramesh Talreja

Tenneco Endowed Professor in the Department of Aerospace Engineering and in the Department of Materials Science and Engineering at Texas A&M University

A cost-effective manufacturing sensitive design strategy using physical modeling and stochastic simulation of defects.



Professor Roberto Teti

Director of the Fraunhofer Joint Laboratory of Excellence on Advanced Production Technology (Fh-J_UniNaples) at the University of Naples Federico II, Italy

Drilling of Advanced Composite Materials for Aerospace Applications.



Prof. Prasad Potluri

Professor of Robotics and Textile Composites, University of Manchester

Robotic Placement of 3D Fibre Architectures for Net-shaped Composites.



Professor Jürgen Fleischer

Director of the research department Machines, Equipment and Process Automation at the wbk Institute of Production Science within the Karlsruhe Institute of Technology (KIT)

Innovative joining technologies for FRP metal hybridization.



Dr Peter Giddings CEng MiMechE

Chief Engineer - iCAP National Composites Centre

Future technologies for next generation aerostructures.

Exhibitors

KISTLER

measure. analyze. innovate.

Kistler is the global leader providing modular solutions in dynamic measurement technology for pressure, force, torque and acceleration applications.

KYOCERA

SGS Precision Tools

Kyocera is active worldwide in a wide range of sectors. Kyocera uses highly sophisticated materials to produce extremely reliable products both for the major global industries as well as its end consumers.

DMG MORI

DMG MORI are a world leading machine tool technology company, with a comprehensive portfolio of products across a range of technologies including 5 axis machining, turning, additive manufacturing, factory automation and digitization.

FRIMO

Group

Frimo supply production equipment that is perfectly tailored to the manufacturing process. This includes both thermoplastic processes (NFPP, LFT, GMT, LWRT, Organo sheets) and thermosetting processes (RRIM, SRIM, SMC, BMC, LFI, RTM).

exactaform

We at exactaform pride ourselves as being specialists in diamond tooling manufacture. Our vision is to be the brand of choice for high quality PCD tooling solutions.



OSG UK Ltd manufactures specialist taps and dies, supported by a range of standard products sourced from OSG Japan.

Programme overview

Venues

 AMRC Knowledge Transfer Centre
  Nuclear AMRC

Thursday 10th October

Registration: 08:00 – 08:45

Opening session / Keynote presentations

Break: 10:05

AMRC Knowledge
Transfer Centre (Room 1)

AMP Technology Centre (Room 2)

Nuclear AMRC (Boardroom)

**Cutting – Thermal
challenges**
Chair:
K. Kerrigan

**Part generation - Defects,
quality and performance**
Chair:
P. Potluri

Life cycle and cost
Chair:
P. Mativenga

Lunch / Demonstrations/ Exhibition: 11:40 - 13:40

**Cutting - Tool and
process development**
Chair:
R. Teti

**Part generation -
Novel forming methods**
Chair:
P. Fairclough

Hybrid parts manufacture #1
Chair:
J. Fleischer

Break: 15:00

**Cutting – Machining
and monitoring**
Chair:
J. Sheikh-Ahmad

Part generation - ATL / AFP
Chair:
H. El-Dessouky

Hybrid parts manufacture #2
Chair:
P. Mativenga

Evening Meal at Cutlers' Hall: 19:00 – 23:00

Programme overview

Venues

 AMRC Knowledge Transfer Centre
  Nuclear AMRC
  Demonstrations

Friday 11th October

Registration: 08:00 – 08:30

Opening session / Keynote presentations

Break: 10:10

Demonstrations: 10:25 - 11:45

Lunch / Exhibition: 11:45 - 12:30

AMRC Knowledge
Transfer Centre (Room 1)

AMP Technology Centre (Room 2)

Nuclear AMRC (Boardroom)

**Part generation -
Novel forming methods #2**
Chair:
H. El-Dessouky

**Cutting -
Non-conventional machining**
Chair:
M. El-Hofy

**Part generation -
Novel forming methods #3**
Chair:
J. Fleischer

Break: 13:50

**Cutting – Experimental and
numerical characterisation**
Chair:
J Merino-Perez

Non-destructive testing (NDT)
Chair:
C. Frias

**Part generation –
Novel materials, methods
and planning**
Chair:
P. Fairclough

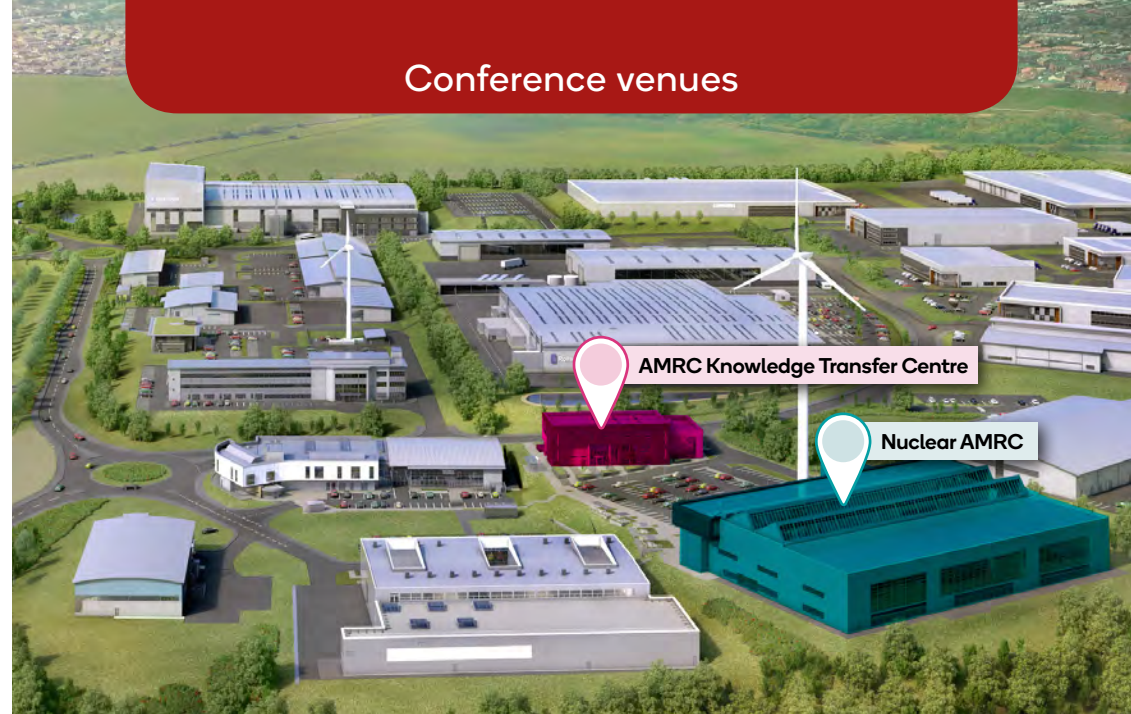
Farewell & Closing Ceremony: 15:25

Conference venues

The conference is being held across the following two venues:

 AMRC Knowledge Transfer Centre

 Nuclear AMRC



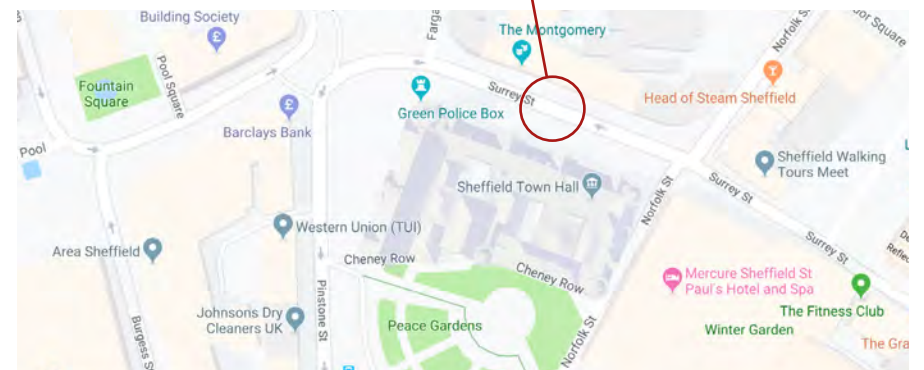
Address:

Advanced Manufacturing Research Centre,
Advanced Manufacturing Park,
Wallis Way, Catcliffe,
Rotherham, S60 5TZ

Shuttle bus:

For delegates staying in Sheffield city centre, we are providing a shuttle bus service to and from the AMRC. Buses will be picking delegates up from **Surrey Street (S1 2LG)** promptly at 07:50am. Please ensure you arrive in plenty of time in order to secure your place on a bus.

Return buses will leave the AMRC at the close of each day and will return delegates to the same pickup location, **Surrey Street (S1 2LG)**.



Taxis:

You can book **City Taxis** online or call them direct on **0114 239 3939** or travel using **UBER**.

Parking:

Parking is available at AMRC Castings / Cti, (marked 'P' on the map opposite). An attendant will be located at the entrance to direct you in.

Evening reception venue:

Wednesday 9th October
18:00 – 23:00

The Sheffield & Tinsley Canal / Hilton Sheffield Hotel,

Victoria Quays, Furnival Road,
Sheffield, S4 7YA.

Suggested dress code:

Lounge suit / Cocktail dress.

By Road: Follow signs from all major routes to the city centre.

By Public Transport: Located in the city centre and easily accessible by all public transport.



Conference dinner venue:

Thursday 10th October
19:00 – 23:00

Cutlers' Hall,

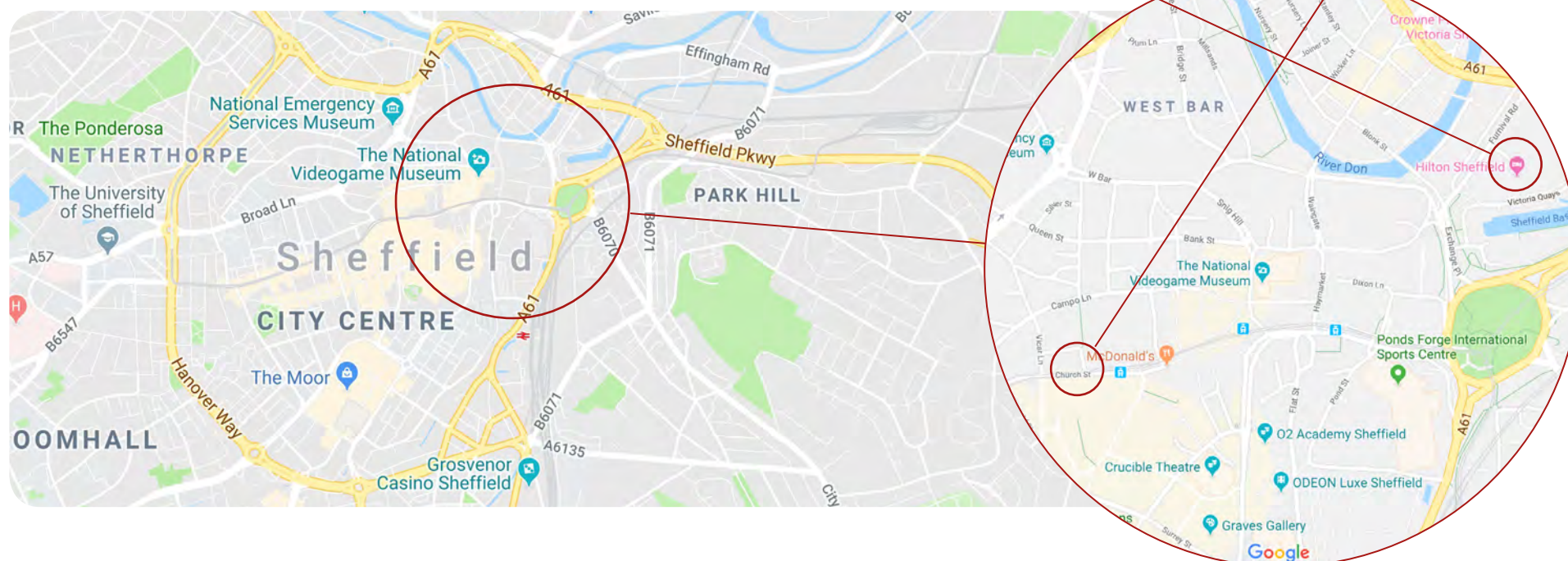
Church St, Sheffield, S1 1HG.

Suggested dress code:

Jacket & tie / Cocktail dress.

The Cutlers' Hall is located 800 metres from Sheffield's Railway Station, a short walk or taxi journey away.

The tram can also be boarded at Sheffield railway station which drops off directly in front of the hall. The nearest tram stop is Cathedral Station.





Known the world over as a Steel City, Sheffield was famed for its industry in the heyday of the 1900s and remains a city of innovation to this day.

However the smoking chimney stacks are no more and instead you'll find a green, modern cityscape set against the stunning backdrop of the Peak District National Park.

We have a friendly, independent and alternative spirit that you won't find in other cities, alongside a thriving cultural scene boasting award-winning theatre, beer, music, festivals, street art and so much more.

It's all here waiting for you: Welcome to Sheffield.

Travelling to Sheffield by Air:

With 4 international airports within less than an hour's drive, Sheffield is easy to reach from overseas destinations.

Manchester Airport, one of the UK's busiest, has a regular direct rail service to Sheffield. Robin Hood Doncaster Sheffield Airport is served by a number of European destinations with charter flight routes. Leeds Bradford Airport is also well served by European and long haul destinations. Sheffield can be reached by using a taxi service or bus to Leeds and then train to Sheffield.

Nottingham East Midlands receives routes from European and long haul destinations. Sheffield can be reached by road using a taxi service, or take the airport shuttle to East Midlands Parkway and take the train (operated by East Midlands Trains) to the centre of Sheffield.

To ensure your easy onward journey from your airport of choice, why not book your airport transfer in advance with one of the private hire taxi companies in Sheffield. You can book City Taxis online or call them direct on 0114 239 3939 or travel using UBER

Travelling to Sheffield by train:

If you are travelling from London, or on routes operated by East Midlands Trains, you might find our 'special event tickets' a value for money travel option.

The mainline station in Sheffield offers an impressive entry to the City, with fast direct links from London St Pancras International departing every 30 minutes from early morning to late at night. Coming in from Europe? The Eurostar link from Paris arrives at London St Pancras International - you can be in Sheffield in just 5 hours after leaving Paris.

The journey from London is now only 2hrs and 1mins, the service is operated by East Midlands Trains with both First and Standard Class seating available. There are also hourly fast trains from Manchester City Centre and direct services from Manchester International airport.

Regional Train Services:

Sheffield is so easy to reach by train, whether you're travelling from North, South, East or West. Take a look at the special offers from TransPennine Express or at the services provided by Northern Rail as great starting points to planning your visit.

Venues



Thursday 10th October

8:00 - 8:45	Registration and Coffee		
8:45 - 9:05	Opening Session, Dr Kevin Kerrigan, Conference Chair		
9:05 - 9:35	Keynote Presentation – Prof. Jürgen Fleischer (see page 6)		
9:20 - 9:50	Keynote Presentation – Prof. Prasad Potluri (see page 6)		
10:05 - 10:20	Coffee Break / Exhibition		
	AMRC Knowledge Transfer Centre (Main room)	AMRC Knowledge Transfer Centre (Room 2)	Nuclear AMRC (Boardroom)
	Cutting – Thermal challenges Chair: K. Kerrigan	Part generation – Defects, quality and performance Chair: P. Potluri	Life cycle and cost Chair: P. Mativenga
10:20 - 10:40	Temperature field due to a moving heat source in machining orthotropic composites with arbitrary fiber orientation. J.P. Mehnert	Residual Stresses Generation In UltraThick Components For Wind Turbine Blades G. Struzziero	Economic evaluation of alternative process chains for the largescale manufacturing of metal-fiber laminates P. Kabala
10:40 - 11:00	Heat partition in edge trimming of glass fiber reinforced polymer (GFRP) composites. F. Almaskari	Influence of layer thickness variations on the structural behavior of optimized fiber reinforced plastic parts M. Franz	Process chain based data capture for a flexible and reliable life cycle inventory of a glass fiber-reinforced thermoplastic lightweight structure M. Müller
11:00 - 11:20	Varying CFRP workpiece temperature during slotting: effects on surface metrics, cutting forces and chip geometry S. Ashworth	Modelling of the Porousness inside 2.5D Carbon/Carbon Composites. M. Luo	A Circular Economy based Decision Support System for the Assembly/Disassembly of Multi-Material Components P. Stavropoulos
11:20 - 11:40	Cryogenic drilling of carbon fibre reinforced plastic with tool consideration. S. Newman	Rapid Multifunctional Composite Part Manufacturing using Controlled in-situ Polymerization of PA6 Nanocomposite R. Gupta	Evaluation of the Technical-Economic Potential of Thermosetting Injection Moulding for Shaping of C/C-SiC-Ceramics J. Stiller
11:40 - 13:40	Lunch/ Demonstrations / Exhibition		

Venues



Thursday 10th October

	AMRC Knowledge Transfer Centre (Main room)	AMRC Knowledge Transfer Centre (Room 2)	Nuclear AMRC (Boardroom)
	Cutting – Tool and process development Chair: R. Teti	Part generation – Novel forming methods Chair: P. Fairclough	Hybrid parts manufacture #1 Chair: J. Fleischer
13:40 - 14:00	Influence of tool coating condition on side milling of amorphous laminated composite block Z. Fang	Kinematic Description and Shape Optimization of UDTape Reinforcements Manufactured with a Novel Preforming Process D. Kupzik	Process-integrated embedding of metal inserts in continuous fibre reinforced thermoplastics J. Troschitz
14:00 - 14:20	Influence of SiC particle volume fraction and texture on the surface properties in milling of AMCs with MCD-tipped tools B. Clauß	Numerical and Experimental Investigation of Thermoplastics in MultiAxis Forming Processes B. Wonnemberg	Computational Manufacturing for Multi-Material Lightweight Parts A. Hürkamp
14:20 - 14:40	Application of niobium carbide based cutting materials for peripheral milling of CFRP P. Meier	Multi-axis additive manufacturing process for continuous fibre reinforced composite parts K. Zhang	Production of Hybrid Tubular Metal-FiberPreforms: Material Characterization of Braided Hoses with a Binder P. Ruhland
14:40 - 15:00	The evolution of cutting forces during slot milling of unidirectional carbon fiber reinforced polymer (UD-CFRP) composites J. Sheikh-Ahmad	Mould-Integrated Heating Technology for Efficient and Appropriate Processing of Fibre-Reinforced Thermoplastics F. Gabriel	Process integration of hot stamping steel and thermoforming fibre-reinforced thermoplastics M. Demes
15:00 - 15:15	Coffee Break / Exhibition		
	Cutting – Machining and monitoring Chair: J. Sheikh-Ahmad	Part generation - ATL / AFP Chair: H. El-Dessouky	Hybrid parts manufacture #2 Chair: P. Mativenga
15:15 - 15:35	Cooling Process of Reverse Air Suctioning for Damage Suppression in Drilling CFRP Composites Z. Jia	Thermoset Prepreg Compaction during Automated Fiber Placement and Vacuum Debulking R. Engelhardt	Towards predicting manufacturing effect on hybrid part efficiency: An automotive case P. Stavropoulos

Programme

Venues



Thursday 10th October

	AMRC Knowledge Transfer Centre (Main room)	AMRC Knowledge Transfer Centre (Room 2)	Nuclear AMRC (Boardroom)
	Cutting – Machining and monitoring Chair: J. Sheikh-Ahmad	Part generation – ATL / AFP Chair: H. El-Dessouky	Hybrid parts manufacture #2 Chair: P. Mativenga
15:35 - 15:55	Monitoring of orbital drilling process in CFRP based on digital image processing of characteristics of uncut fibres N. Geier	Temperature analysis for the laser-assisted tape winding process of multi-layered composite pipes M. Schäkel	Model-based Heating and Handling Strategy for Pre-Assembled Hybrid Fibre-Reinforced Metal-Thermoplastic Preforms F. Gabriel
15:55 - 16:15	Pocket milling of composite fibre-reinforced polymer using industrial robot E. Grisolo Melo	In Situ Joining of Unidirectional Tapes on Long Fiber Reinforced Thermoplastic Structures by Thermoplastic Automated Fiber Placement for Scientific Sounding Rocket Applications R. Engelhardt	Scalable Process Chain for Flexible Production of Metal-Plastic Lightweight Structures A.K. Reichler
16:15 - 16:35	An assessment of two technologies for high performance composite machining; adaptive fixturing and in process tool profile monitoring A. Bey Tamsamani	Adaptive tape placement process control at geometrically changing substrates P. Striet	Overmoulding of consolidated fibre-reinforced thermoplastics – increasing the bonding strength by physical surface pre-treatments A. Liebsch
16:35 - 16:55	Influence of cutting edge radius on process forces in orthogonal machining of carbon fibre reinforced plastics (CFRP) K. Sauer	A Digital Shadow for the Infrared-based Tape Laying Process of Tailored Blanks out of Thermoplastic Unidirectional Tape M. Schulz	End milling as a surface pretreatment for adhesive bonding of CFRP - new approaches for root cause identification of reduced bond line performance J. de Freese
16:55	Close of day		

Programme

Venues



Friday 11th October

8:00 - 8:30	Registration and Coffee		
8:30 - 9:00	Keynote Presentation – Prof. Roberto Teti (see page 6)		
9:00 - 9:40	Keynote Presentation – Prof. Ramesh Talreja (see page 6)		
10:00 - 10:10	Keynote Presentation – Dr. Peter Giddings (see page 6)		
10:10 - 10:25	Coffee Break		
10:25 - 11:45	Demonstrations		
11:45 - 12:30	Lunch		
	AMRC Knowledge Transfer Centre (Main room)	AMRC Knowledge Transfer Centre (Room 2)	Nuclear AMRC (Boardroom)
	Part generation – Novel forming methods #2 Chair: H. El-Dessouky	Cutting – Non-conventional machining Chair: M. El-Hofy	Part generation – Novel forming methods #3 Chair: J. Fleischer
12:30 - 12:50	Towards mould free composites manufacturing of thermoset preregs. Incremental curing with localised pressure-heat V. M. Cedeno-Campos	Laser Based Machining of Aluminum Metal Matrix Composites J. Dunleavey	Compression RTM of reactive thermoplastic composites using microwaves and cure monitoring N. Pantelelis
12:50 - 13:10	Effect of the injection moulding fibre orientation distribution on the fatigue life of short glass fibre reinforced plastics for automotive applications A. Lizama	Pure waterjet controlled depth machining for stripping ceramic thermal barrier coatings on turbine blades M. Schüler	Integrated Gripping-System for Heating and Preforming of Thermoplastic Unidirectional Tape Laminates J. Fleischer
13:10 - 13:30	Co-woven carbon and nylon fibres for manufacturing thermoplastic composite plaques H. El-Dessouky	A comparative study of the effects of milling and abrasive water jet cutting on flexural performance of CFRP M. Monoranu	Development and Optimization of Carbon Fibre Reinforced Polymers for Rail Car Applications I. Daniyan
13:30 - 13:50	Improved Energy Absorption in 3D Woven Composites by Weave Parameter Manipulation G. Neale	A comparison between conventional and ultrasonic-assisted GFRP machining M. Rabiey	Experimental investigation on fabrication of thermoset prepreg composites using automated fiber placement process and 3D printed substrate R. Velu
13:50 - 14:05	Coffee Break		

Venues



Friday 11th October

	AMRC Knowledge Transfer Centre (Main room)	AMRC Knowledge Transfer Centre (Room 2)	Nuclear AMRC (Boardroom)
	Cutting – Experimental and numerical characterisation Chair: J. Merino-Perez	Non-destructive testing (NDT) Chair: C. Frias	Part generation – Novel materials, methods and planning Chair: P. Fairclough
14:05 - 14:25	Chip formation in machining of unidirectional carbon fibre reinforced polymer laminates: FEM based assessment F. Cepero	Evaluation of anomaly detection capabilities using a non-orthogonal camera angle in pulsephase thermography L. Bretz	The effect of type of mechanical processing on conductivity and piezoresistive response of CNT and graphite composites M. Collinson
14:25 - 14:45	Experimental Analysis on Drilling of Al/Ti/CFRP Hybrid Composites M. Kayihan	Automated NDT inspection based on high precision 3-D Thermo-Tomography model combined with engineering and manufacturing data A. Huber	Automated fixation of dry carbon fibre fabrics with RTM6 for autonomous draping and sensor-aided preforming C. Frommel
14:45 - 15:05	Wet drilling of CFRP composites: a comparison of cutting fluid delivery methods J. L Merino-Pérez	Towards flexible and defect-free forming of composites through distributed clamping R. Jagpal	Algorithm-based verification of manufacturing constraints for a loadpath reinforced fabric P. Gebhardt
15:05 - 15:25			Fused Deposition Modelling Filament with Recyclate Fibre Reinforcement M. Morsidi
15:25	Farewell & Closing Ceremony		

On-Machine Demonstrations

- AMRC Composite Centre**
Advanced Curing
Automated Production
Composites Machining
Dry Fibre Technologies
Novel Materials & Processing
- AMRC Press Building**
High Pressure Resin Transfer Molding (HP-RTM) demonstration.
- Design and Prototyping Centre**
Demonstration on the new DMG Mori DMU 340 G linear ultrasonic assisted 5-axis machining centre.
- Factory 2050**
Virtual tour of our new dry fibre technologies facility that houses our Herzog Radial Braider, robotic trimming and fault recognition capabilities.

WiFi password

- The service is found by the label 'WiFiGuest'.
- Where it says 'Get online at Sheffield University' in the middle of the page click 'Go' then click 'Create Account'.
- Users will need to register with the service by completing the appropriate fields. This is a one-time only registration that is required to access the service.
- Once successfully registered, the device will automatically authenticate and connect.

For help: see Sky's page at www.skywifi.cloud
To report issues: please call IT on 0114 215 8100

Conference venue – Advanced Manufacturing Research Centre
www.amrc.co.uk

Evening reception venue – Hilton Hotel Sheffield
www.hilton.com/sheffield

Conference dinner venue – Cutlers' Hall
www.cutlershall.co.uk

Public transport
www.travelsouthyorkshire.com

About Sheffield
www.welcometosheffield.co.uk

- Organisation of the conference**
- www.amrc.co.uk/cirp-ccmpm2019
 - cirp-ccmpm2019@amrc.co.uk
 - 0114 222 7680

Thanks to the Industrial Doctorate Centre (IDC) in Machining Science for their help in organising this conference.



The IDC in Machining Science is a unique collaboration between the University of Sheffield's Advanced Manufacturing Research Centre (AMRC) and the Faculty of Engineering.

The IDC provides EngD and PhD training with a focus on machining science. Our aim is to bring together the brightest engineering postgraduates, academic expertise and industrial partners to develop new technologies and skills for the benefit of all partners.

The IDC has dedicated work space for students on main campus, and also at the AMRC research facilities on the Advanced Manufacturing Park, Catcliffe (see Contact Information for our location). Research mainly takes place at AMRC where students have access to state-of-the-art facilities and highly skilled staff. Teaching takes place on main campus with academic perspective provided by staff from the Faculty of Engineering.

For more information and a list of our latest PhD and EngD opportunities, please see the IDC website at www.ms-idc.co.uk



Thanks to the University of Manchester Department of Materials for their support with this conference.

We are the largest Department of Materials in Europe, excelling in both materials science and engineering, and fashion business and technology.

We attract the best research talent from across the globe, offering invaluable hands-on experience in custom laboratories and digital design studios. They are the home of graphene and our continued investment in materials includes the creation of our £235 million Henry Royce Institute and our £60 million Graphene Engineering Innovation Centre.

DMG MORI

Thanks to DMG Mori for their support in facilitating the on-machine demonstration.

DMG MORI is a worldwide leader of cutting machine tools for turning and milling, as well as a comprehensive supplier in additive manufacturing using powder sing powder nozzle or powder bed technologies.

Digitization is changing our world both quickly and radically. The switch to digitization requires fundamental further development which can only be achieved globally and jointly, in strong partnerships and on an equal footing. DMG MORI continues to develop positively – technologically, structurally and culturally. Our business is marked by Dynamic and Excellence.



Thanks to Frimo for their support in in facilitating on-press demonstrations.

With FRIMO, you can rely on many years of extensive experience in efficiently processing composites in high volumes.

Typical applications include structural or hybrid components or as the substitution of steel or aluminium. Our technologies are already successfully used in the automotive industry for manufacturing monocoques, panelling components, floor structures, seat cushions, door panels, ceiling panels, wheel rims, and springs made of fiber-reinforced composites.

With us, you get everything from one source – component design, material selection, tool and machine design and production, and prototype and pre-series parts production in our TechCenters.



AMRC /
ADVANCED MANUFACTURING
RESEARCH CENTRE



The
University
Of
Sheffield.

Supported by

 **idc** Machining
Science.

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AMRC

University of Sheffield
Advanced Manufacturing Park
Wallis Way, Catcliffe
Rotherham, S60 5TZ

e: enquiries@amrc.co.uk

t: +44 (0)114 222 1747

w: amrc.co.uk

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