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# 9th CIRP Conference

## on High Performance Cutting

24th - 26th May 2021

Monday 24th May 2020			
Logging into the conference			
Opening session-Dr Erdem Ozturk Introduction to AMRC - Steve Foxley, AMRC			
The future of global manufacturing and machine tool industry KN1- Dr Masahiko Mori, DMG MORI			
The Journey to Future Smart Machining Systems KN2- Dr Donka Novovic, Rolls-Royce			
Theme presentations			
1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16
17	21	25	29
18	22	26	30
19	23	27	31
20	24	28	32
End of Day1			

Tuesday 25th May 2020			
Logging into the conference			
Opening session- David Curtis			
On the Path to Autonomous Machine Tools KN3- Prof Berend Denkena, IFW, Leibniz University			
Sponsored Technical Presentation Stephen George, Kennametal			
Theme presentations			
33	37	41	45
34	38	42	46
35	39	43	47
36	40	44	48
49	53	57	61
50	54	58	62
51	55	59	63
52	56	60	64
End of Day2			

Wednesday 26th May 2020			
Logging into the conference			
Opening session- Dr Hassan Ghadbeigi			
A contribution to the understanding of tool/workpiece interaction in high performance metal cutting KN4 - Prof Susanne Norgren, Sandvik Coromant			
Sponsored Technical Presentation Nishant Saini, Thirdwave Systems			
Theme presentations			
65	69	73	77
66	70	74	78
67	71	75	79
68	72	76	80
81	85	89	93
82	86	90	94
83	87	91	95
84	88	92	96
End of the conference			



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Theme		Topic
Theme 1: Cutting Processes	a	Machining of metallic materials
	b	Machining of difficult-to-cut, non-metallic materials, composites
	c	Cutting tool materials, tool design and tool performance
	d	Residual stress and damage of finished surfaces due to cutting
Theme 2: Sustainability and Digitalisation	a	Sustainable manufacturing, environmental aspects of machining
	b	CAD / CAM systems and strategies for high performance cutting
	c	Cyber-physical approaches
	d	Intelligent tooling
Theme 3: Mechanics, Dynamics and Machines	a	Mechanics and dynamics of material removal processes
	b	Dynamics, monitoring and control of machining operations
	c	Machine design, structures and configurations
	d	Control of multi-axis machine tools
	e	Robotic machining
Theme 4: Abrasive Processes, Electro-Physical-Chemical Processes, Metrology	a	Abrasive processes
	b	Hybrid machining
	c	Non-conventional machining
	d	Metrology and measurement



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## Theme 1: Cutting Processes

	Paper Ref	Topic	Paper Title	Presenting Author	Corresponding Author	
Monday	1 PROCIR-D-19-01725	Machining of metallic materials	Analysis and optimization of surface roughness in turning of AA6061-T6 under various environments and parameters	Mahshad Javidikia	Victor Songmene	
	2 PROCIR-D-19-01731	Machining of metallic materials	Performance increase by process parameter variation during turning of AISI 4140	Andreas Relard	Andreas Relard	
	3 PROCIR-D-19-01834	Machining of metallic materials	Anisotropy effect on Laser Powder Bed Fused Ti6Al4V machinability	Lucia Lizzul	Lucia Lizzul	
	4 PROCIR-D-19-01741	Machining of metallic materials	Hardness and Orthogonal Cutting Analyses of a Wire and Arc Additive Manufactured (WAAM) Sample	Sarah Eschelbacher	Sarah Eschelbacher	
	17 PROCIR-D-20-00430	Machining of metallic materials	Tool wear progression of SiAlON ceramic end mills in five-axis high-feed rough machining of an Inconel 718 BLISK	Richard Zimmermann	Richard Zimmermann	
	18 PROCIR-D-19-01755	Machining of difficult-to-cut, non-metallic materials, composites	The effect of cutting parameter changeover position on interface borehole quality in drilling of aerospace CFRP/Al stacks	Andrea Pardo	Robert Heinemann	
	19 PROCIR-D-19-01819	Machining of difficult-to-cut, non-metallic materials, composites	Influence of different cooling strategies on the process temperatures and chip transport quality in one-shot drilling CFRP/Al-stacks	Lukas Seeholzer	Lukas Seeholzer	
	20 PROCIR-D-19-01820	Machining of difficult-to-cut, non-metallic materials, composites	Influence of drilling parameters on thrust force and burr on fiber metal laminate (Al 2024-T3/glass fiber reinforced epoxy)	Eduardo Bonhin	Eduardo Bonhin	
	Tuesday	33 PROCIR-D-19-01951	Machining of difficult-to-cut, non-metallic materials, composites	High performance machining of continuous metal fibers with cascaded multi-stage profile tools	Uwe Teicher	Uwe Teicher
		34 PROCIR-D-19-01960	Machining of difficult-to-cut, non-metallic materials, composites	Investigation of cutting mechanisms in the machining of Ceramic Matrix Composites (CMCs)	Philipp Ganser	Jannik Reisberg
35 PROCIR-D-19-01974		Machining of difficult-to-cut, non-metallic materials, composites	Wear characteristics of micro-drill during ultra-high speed drilling multi-layer PCB consisting of copper foil and ceramic particle filled GFRPs	Huang Xin	Lijuan Zheng	
36 PROCIR-D-19-01723		Cutting tool materials, tool design and tool performance	Wear behaviour of various CVD diamond thick film specifications during turning Ti-6Al-4V	Danny Schröter	Danny Schröter	
49 PROCIR-D-19-01728		Cutting tool materials, tool design and tool performance	Influence of the thickness of nanolayers in wear-resistant layer of Ti-TiN-(Ti,Cr,Al)N coating on the tool life and wear pattern of the carbide cutting tools in steel turning	Alexey Vereschaka	Alexey Vereschaka	
50 PROCIR-D-19-01739		Cutting tool materials, tool design and tool performance	Boron-doped monocrystalline diamond as cutting tool for temperature measurement in the cutting zone	Toni Hocke	Toni Hocke	
51 PROCIR-D-19-01758		Cutting tool materials, tool design and tool performance	cBN-based cutting tools with niobium compounds as a binder phase.	Kateryna Slipchenko	Kateryna Slipchenko	
52 PROCIR-D-19-01791		Cutting tool materials, tool design and tool performance	Study of new solid end mill for side milling of Ti-6Al-4V with improved cooling efficiency	Raghuveer Gaddam	Raghuveer Gaddam	
Wednesday	65 PROCIR-D-19-01792	Cutting tool materials, tool design and tool performance	Tool lifetime when drilling Inconel 718 in dependence of the cooling channel design – Influence of the clearance angle, the channel diameter, number and shape	Daniel Müller	Daniel Müller	
	66 PROCIR-D-19-01837	Cutting tool materials, tool design and tool performance	Application of Cr,Mo-(Cr,Mo)N-(Cr,Mo,Zr,Nb,Al)N multilayered composite multicomponent coating to increase the cutting tool life in turning steel	Alexey Vereschaka	Alexey Vereschaka	
	67 PROCIR-D-19-01844	Cutting tool materials, tool design and tool performance	A study of the lubrication regimes of the contact surfaces of laser textured CVD coated cutting tools	Paul Butler-Smith	Paul W. Butler-Smith	
	68 PROCIR-D-19-01631	Residual stress and damage of finished surfaces due to cutting	Simulation of the coupling effect of bulk and induced residual stresses on machining distortion	Ravi Bilkhu	Ravi Bilkhu	
	81 PROCIR-D-19-01972	Residual stress and damage of finished surfaces due to cutting	Working point determination of 3MA micromagnetic NDT-technique for production integrated detection of white layer during turning of AISI4140	David Böttger	David Böttger	
	82 PROCIR-D-19-01975	Residual stress and damage of finished surfaces due to cutting	Prediction of near surface residual stress states for hard turned specimens using data driven nonlinear models	Christopher Schott	Christopher Schott	
	83 PROCIR-D-19-02219	Residual stress and damage of finished surfaces due to cutting	Comparative Analysis of Residual Stress and Dislocation Density of Machined Surface during Turning of High Strength Steel	Jiang Hongwan	Hongwan Jiang	
	84 PROCIR-D-20-00066	Residual stress and damage of finished surfaces due to cutting	Residual stress characterization for ribbed geometries using On-machine Layer Removal method	Maria Aurrekotxea	Maria Aurrekotxea	



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## Theme 2: Sustainability and Digitalisation

	Paper Ref	Topic	Paper Title	Presenting Author	Corresponding Author
Monday	5 PROCIR-D-19-01647	Sustainable manufacturing, environmental aspects of machining	Effect of various cooling lubricant strategies on turning Inconel 718 with different cutting materials	Nicolai Ostrowicki	Daniel Gross
	6 PROCIR-D-19-01788	Sustainable manufacturing, environmental aspects of machining	High-speed milling Inconel 718 using Electrostatic Minimum Quantity Lubrication (EMQL)	Andrea De Bartolomeis	Andrea De Bartolomeis
	7 PROCIR-D-19-01808	Sustainable manufacturing, environmental aspects of machining	Sustainable machining of Ti-6Al-4V using cryogenic cooling: an optimized approach	Ahmed Damir	Ahmed Damir
	8 PROCIR-D-19-01828	Sustainable manufacturing, environmental aspects of machining	Sub-zero metalworking fluids for high performance cutting of difficult to cut materials	Stephan Basten	Stephan Basten
	21 PROCIR-D-19-01841	Sustainable manufacturing, environmental aspects of machining	Economic and ecological evaluation of high-pressure cutting fluid supply in milling of Ti-6Al-4V	Thomas Lakner	Thomas Lakner
	22 PROCIR-D-19-01998	Sustainable manufacturing, environmental aspects of machining	Thermal analysis in MQL end milling operations	Alborz Shokrani	Alborz Shokrani
	23 PROCIR-D-19-02008	Sustainable manufacturing, environmental aspects of machining	Milling of aerospace alloys using supercritical CO2 assisted machining	Nikolaos Tapoglou	Nikolaos Tapoglou
	24 PROCIR-D-19-02011	Sustainable manufacturing, environmental aspects of machining	Correlation between tool life and cutting force coefficient as the basis for a novel method in accelerated MWF performance assessment	Matthew Broderick	Matthew Broderick
Tuesday	37 PROCIR-D-19-01754	CAD / CAM systems and strategies for high performance cutting	Optimised process planning for re-contouring of repair-welded tool moulds by using a specific force model	Klaas Heide	Klaas Heide
	38 PROCIR-D-19-01763	CAD / CAM systems and strategies for high performance cutting	New mechanistic model to predict machining time for milling free form geometries using 4-axis milling	Felipe Marin	Adriano Souza
	39 PROCIR-D-19-01770	CAD / CAM systems and strategies for high performance cutting	New algorithm identifies the best set of cutting tools to mill cavities	Rodrigo Berretta Käsemödel	Adriano Souza
	40 PROCIR-D-19-01789	CAD / CAM systems and strategies for high performance cutting	New algorithm to calculate the cutter location points (CL) optimizing the chordal tolerance for 2 1/2 axis milling of free form surfaces	Nicolas Severino	Adriano Souza
	53 PROCIR-D-19-01790	CAD / CAM systems and strategies for high performance cutting	Optimization of Tool Axis Orientations in Multi-Axis Toolpaths to Increase Surface Quality and Productivity	Michal Stejskal	Michal Stejskal
	54 PROCIR-D-19-01949	CAD / CAM systems and strategies for high performance cutting	Production technology research – Building blocks for competitiveness and solution for future challenges in aerospace component manufacturing	Gregor Kappmeyer	Gregor Kappmeyer
	55 PROCIR-D-19-02004	CAD / CAM systems and strategies for high performance cutting	Process planning for the machining of Ti-6Al-4V near-net shaped components	Christina Fuchs	Christina Fuchs
Wednesday	69 PROCIR-D-19-01726	Cyber-physical approaches	A prediction model for high efficiency machining conditions based on machine learning	Kengo Kawai	Kengo Kawai
	70 PROCIR-D-19-01753	Cyber-physical approaches	Comparison of Machine Learning Methods for Quality Prediction of Drilled and Reamed Bores Based on NC-Internal Signals	Sebastian Schorr	Sebastian Schorr
	71 PROCIR-D-19-01766	Cyber-physical approaches	The Concept of Digital Twin and Digital Shadow in Manufacturing	Thomas Bergs	Thorsten Augspurger
	72 PROCIR-D-19-01772	Cyber-physical approaches	A statistics based Digital Twin for the combined consideration of heat treatment and machining for predicting distortion	Kareema Hilton	Kareema Hilton
	85 PROCIR-D-19-01724	Intelligent tooling	Real time monitoring of cutting edge temperature by a fiber-optic two-color pyrometer and its effect on tool wear	Jinghui Han	Guanglan Liao
	86 PROCIR-D-19-01748	Intelligent tooling	Wear-resistive thin-film sensors on cutting tools for in-process temperature measurement	Marcel Plogmeyer	Marcel Plogmeyer
	87 PROCIR-D-19-02218	Intelligent tooling	Real-time compensation of tool deflection using a sensor embedded boring bar with wireless signal feedback to the machine tool controller	Dan Östling	Dan Östling



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## Theme 3: Mechanics, Dynamics and Machines

	Paper Ref	Topic	Paper Title	Presenting Author	Corresponding Author	
Monday	9	PROCIR-D-19-01722	Mechanics and dynamics of material removal processes	Simulation of metal cutting with cutting fluid using the Finite Pointset Method	Enrico Barth	Enrico Barth
	10	PROCIR-D-19-01740	Mechanics and dynamics of material removal processes	Application of machine drive oscillations for chip breaking in heavy duty turning operations	Asier Astarloa	Jokin Munoa
	11	PROCIR-D-19-01823	Mechanics and dynamics of material removal processes	Logistic classification for tool life modeling in machining	Jaydeep Karandikar	Jaydeep Karandikar
	12	PROCIR-D-19-01824	Mechanics and dynamics of material removal processes	Comparative analysis of cutting forces and stability of standard and non-standard profiled serrated end mills	Pritam Bari	Mohit Law
	25	PROCIR-D-19-01830	Mechanics and dynamics of material removal processes	Description of the Kinematics based on a Simulation Tool and Analysis of the Interaction of the Gimbal in Precision Honing	Murat Güner	Sven Klein
	26	PROCIR-D-19-01833	Mechanics and dynamics of material removal processes	Surface form error prediction for 3-axis milling operations	Lorenzo Morelli	Niccolò Grossi
	27	PROCIR-D-19-01842	Mechanics and dynamics of material removal processes	Improvement of material databases for cutting force prediction in finishing conditions of A-356 aluminium alloy	Xabier Lazkano	Xabier Lazkano
	28	PROCIR-D-19-01855	Mechanics and dynamics of material removal processes	Comparative study of stability predictions in micro-milling by using cutting force models and direct cutting force measurements	Shukri Afazov	Shukri Afazov
	41	PROCIR-D-19-01961	Mechanics and dynamics of material removal processes	Clamping modeling in automotive flexible workpieces machining	Philippe Lorong	Philippe Lorong
Tuesday	42	PROCIR-D-19-01982	Mechanics and dynamics of material removal processes	Experimental study on macroscopic force modelling for surface grinding processes in aerospace industry	Adina Grimmert	Adina Grimmert
	43	PROCIR-D-19-02015	Mechanics and dynamics of material removal processes	Regenerative instabilities of spring-guided circular saws	Mohit Law	Mohit Law
	44	PROCIR-D-19-01832	Machine design, structures and configurations	Effect of expansion coefficient difference between machine tool and workpiece to the thermal deformation induced by room temperature change	Kotaro Mori	Kotaro Mori
	57	PROCIR-D-19-01987	Control of multi-axis machine tools	Synchronization motion accuracy measurement method for coordinated five-axis machine tools	Xu Kun	Qingzhen Bi
	58	PROCIR-D-19-01635	Robotic machining	Postprocessor for Verification of Robot Movements with Additional Axis after Toolpath Optimization	Tomas Kratena	Petr Vavruska
	59	PROCIR-D-19-01733	Robotic machining	Configuration optimization through redundancy angle and tool posture by force induced error index in robot ball-end milling	Zepeng Li	Fangyu Peng
Wednesday	60	PROCIR-D-21-00035	Robotic machining	Integration and demonstration of force controlled support in pocket milling	Patrick Ludwig Fenou Kengne	Patrick Ludwig Fenou Kengne
	73	PROCIR-D-19-01730	Dynamics, monitoring and control of machining operations	Improvement of machining accuracy by measurement and adjustment of dynamic runout of endmill	Atsushi Matsubara	Kaito Nakatani
	74	PROCIR-D-19-01793	Dynamics, monitoring and control of machining operations	Determination of the process damping coefficient using plain cutting tests	Lars Ellersiek	Lars Ellersiek
	75	PROCIR-D-19-01803	Dynamics, monitoring and control of machining operations	Increasing Part Geometric Accuracy in High Speed Machining using Cascade Iterative Learning Control	Rob Ward	Rob Ward
	76	PROCIR-D-19-01810	Dynamics, monitoring and control of machining operations	Design optimization of tool holder extension for enhanced chatter stability by using component mode tuning method	Gamze Karataş	Gamze Karataş
	89	PROCIR-D-19-01968	Dynamics, monitoring and control of machining operations	Flank face interaction in high magnitude chatter investigation in time domain	Guskov Mikhail	Guskov Mikhail
	90	PROCIR-D-19-01991	Dynamics, monitoring and control of machining operations	An adaptive fixture for suppress vibrations and measuring workpiece deformation of thin-walled casings	Chai Shilin	Qingzhen Bi



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## Theme 4: Abrasive Processes, Electro-Physical-Chemical Processes, Metrology

	Paper Ref	Topic	Paper Title	Presenting Author	Corresponding Author	
Monday	13 PROCIR-D-19-01735	Abrasive processes	Pendulum and creep feed grinding of additively manufactured AISI 316L	Benjamin Kirsch	Hendrik Hotz	
	14 PROCIR-D-19-01742	Abrasive processes	An investigation of additively manufactured coolant nozzles for cylindrical grinding applications and progression to high stock removal	Erica Smith	Erica Smith	
	15 PROCIR-D-19-01773	Abrasive processes	High performance grinding of titanium alloys with electroplated diamond wheels	Zhongde Shi	Zhongde Shi	
	16 PROCIR-D-19-01805	Abrasive processes	Effect of the grinding process on the wear of a cemented tungsten carbide cutting insert during turning	Carlos Ventura	Carlos Ventura	
	29 PROCIR-D-19-01812	Abrasive processes	Integration of process monitoring and machine condition diagnostics to improve quality prediction in grinding	Muhammad Ahmer	Muhammad Ahmer	
	30 PROCIR-D-19-01813	Abrasive processes	Tool wear behavior of alumina abrasive wheels during grinding FGH96 powder metallurgy nickel-based superalloy	Li Benkai	Wenfeng DING	
	31 PROCIR-D-19-01814	Abrasive processes	Micro-analysis of the contact zone between vitrified bonded CBN segment and diamond grit during the dressing process	Li Min	Wenfeng DING	
	32 PROCIR-D-19-01954	Abrasive processes	An investigation into the challenges of the point grinding machining process	Nikita Pietrow	Nikita Pietrow	
	Tuesday	45 PROCIR-D-19-01985	Abrasive processes	The influence of contact force variation on surface topographies within high precision cutlery fine grinding	Max Radetzky	Max Radetzky
		46 PROCIR-D-19-02223	Abrasive processes	Pressure conditions during the immersed tumbling process	Yves Kuche	Yves Kuche
47 PROCIR-D-19-01721		Hybrid machining	Binder influence on green ceramic machining by means of milling and laser machining	Anthonin Demarbaix	Anthonin Demarbaix	
48 PROCIR-D-19-01769		Hybrid machining	Understanding the Influence of Chemical and Thermal Loads on the Productivity for Processing 42CrMo4 Steel and Titanium via Laser-Induced Thermochemical Machining	Andreas Klink	Andreas Klink	
61 PROCIR-D-19-01818		Hybrid machining	Ultrasonic assisted drilling of cemented carbide	Falk Protz	Falk Protz	
62 PROCIR-D-19-01831		Hybrid machining	Hybrid Manufacturing Processes: an experimental machinability investigation of DED produced parts	Thanassis Souflas	Panagiotis Stavropoulos	
63 PROCIR-D-19-01963		Hybrid machining	Numerical modelling and experimental investigation of laser-assisted machining of slip cast fused silica ceramics	Berk Tekkaya	Berk Tekkaya	
64 PROCIR-D-19-01751		Non-conventional machining	Experimental investigation of abrasive properties in waterjet machining	Manuel Schöler	Manuel Schöler	
Wednesday		77 PROCIR-D-19-01762	Non-conventional machining	Automotive hybrid design production and effective end machining by novel abrasive waterjet technique	Manuel Schöler	Manuel Schöler
		78 PROCIR-D-19-01775	Non-conventional machining	Process Performance of High Energy Wire EDM	Ugur Küpper	Ugur Küpper
		79 PROCIR-D-19-01992	Non-conventional machining	Experimental Study on the Correlation of Cutting Head Vibrations and Kerf Characteristics during Abrasive Waterjet Cutting of Titanium Alloy	Angelos Markopoulos	Angelos Markopoulos
		80 PROCIR-D-19-01752	Metrology and measurement	Investigation on probe positioning errors affecting on-machine measurements on ultra-precision turning machines	Marco Buhmann	Marco Buhmann
		93 PROCIR-D-19-01779	Metrology and measurement	Integration of On-machine Surface Measurement into Fast Tool Servo Machining	Wenbin Zhong	Wenbin Zhong
		94 PROCIR-D-19-01800	Metrology and measurement	Pneumatic non-contact measuring system for in-process dimensions measurements.	Mohamed Damir	Mohamed DAMIR