



# FSWP 2017

**5<sup>th</sup> International Conference on Scientific and Technical  
Advances on Friction Stir Welding & Processing**

Metz - 11, 12 and 13 October 2017



The **Institut de Soudure Group** has 25 centers in France and 10 abroad; it employs over 1,100 people and lends its expertise to the world of industry. Through its R&D platforms and its expertise, which has been renowned for over 100 years, the training it provides in its training centers and its two schools – ESSA and EAPS –, the Group caters to the welding branch and related controls. It provides innovative solutions to companies all over the world, during design, manufacture or maintenance of welded equipment and multi-materials assemblies, either metallic or composite. To ensure risk control in the world of industry and to guarantee product quality, it offers inspection and testing services as well as metallurgic expertise.



ORGANIZING COMMITTEE
Dr. Sandra CHEVRET, associate professor at Arts et Métiers ParisTech, campus of Metz
Amarily BEN ATTAR, specialist in FSW at Institut de Soudure
Dr. Laurent LANGLOIS, associate professor at Arts et Métiers ParisTech, campus of Metz

**Arts et Métiers** is a French leading Institute of Technology that provides undergraduate and graduate education in 3 main fields: power engineering, industrial engineering and mechanical engineering. It includes 8 education and research campuses (Paris, Angers, Bordeaux, Aix-en-Provence, Cluny, Châlons-en-Champagne, Lille and Metz) and 3 Institutes across France. With 15 research laboratories and 1 PhD program, Arts et Métiers develops teaching and research activities in five strategic fields: Future of manufacturing, Mobility, Energy, Health Technology and Construction. The expertise and research activities at Arts et Métiers cover the complete life cycle of a product: design, industrialization, maintenance, durability and product recycling.

**The Laboratory of design, manufacturing and control** (in French : Laboratoire de conception fabrication commande), also known as the LCFC, is a French laboratory of research located in Metz.

It is under the authority of Arts et Métiers ParisTech and University of Lorraine. The researches of LCFC has been involved with a number of different projects in manufacturing, engineering design and optimization, forging and assembly process modelling and control and robotic design and control. The laboratory includes 35 researcher, 2 office managers and 21 PhD students.



DAY 1 - WEDNESDAY 11		
8h00	Registration	
8h50 - 9h00	Welcome and introduction – ROOM 1	
9h00 - 9h30	PLENARY Room 1	
9h30 – 10h30	APPLICATION 1 Room 1	
10h30 - 10h50	Coffee break	
10h50 – 12h30	APPLICATION 2 Room 1	
12h30 – 13h00	Official opening – Local authorities Room 1	
13h00 - 14h20	Lunch	
14h20 – 14h40	CONTROL AND REPAIR Room 1	MODELLING Room 2
15h40 - 16h10	COFFE BREAK	
16h10 – 17h30	PROCESS DEVELOPMENTS Room 1	ROBOTICS AND TECHNIQUES Room 2
17h50 – 23h30	SOCIAL EVENT	

DAY 2 - THURSDAY 12		
8h30 – 9h00	PLENARY ROOM 1	
9h00 – 10h00	PLENARY ROOM 1	
10h00 - 10h20	Coffee break	
10h20 – 12h20	FRICITION STIR PROCESSING Room 1	FRICITION STIR SPOT Room 2
12h20 - 14h40	LUNCH AND VISITS	
14h40 – 15h40	MICROSTRUCTURE AND DISSIMILAR 1 Room 1	
15h40 - 16h00	Coffe break	
16h00 – 17h40	MICROSTRUCTURE AND DISSIMILAR 2 Room 1	
17h40 - 17h50	CLOSING	

**DAY 3 – FRIDAY 13 (Institut de Soudure lab visit)**

8h00 onwards	REGISTRATION		
8h50 - 9h00	Welcome and introduction		
KEYNOTE 1	PLENARY– ROOM 1 (Grand Amphi) Chair: A. BEN ATTAR		
9h00 - 9h30	J.Dos Santos, A.Barbini, R.Brzostek, J.Carstensen, L.Bergmann, U.Suhuddin	Helmholtz-Zentrum Geesthacht (Germany)	Rivetless Aircraft Structures: Possible solutions based on friction stir and derivative processes
SESSION 1	APPLICATION 1 - ROOM 1 (Grand Amphi) Chair: A. BEN ATTAR and F. MARIE		
9h30 - 9h50	Y.Hovanski <sup>1</sup> , T.Luzanski <sup>2</sup> , D.Marshall <sup>2</sup> , P.Upadhyay <sup>3</sup>	Brigham Young University <sup>1</sup> TWB Company <sup>2</sup> Pacific Northwest National Laboratory <sup>3</sup> (USA)	High Volume Production Validation of Aluminum Tailor-Welded Blanks
9h50 - 10h10	J.Gandra <sup>1</sup> , P.Santos <sup>1,2</sup> , J.Liu <sup>3</sup> , D.Szegda <sup>4</sup> , L.Wang <sup>3</sup> , R.Miranda <sup>2</sup> , K.Beamish <sup>1</sup>	TWI <sup>1</sup> (UK) UNIDEMI <sup>2</sup> (Portugal) Imperial College London, South Kensington Campus <sup>3</sup> (UK) Impression Technologies Ltd <sup>4</sup> (UK)	Combining FSW with HFQ to manufacture aluminium alloy tailor welded blanks for automotive applications
10h10 – 10h30	P.Champion <sup>1</sup> , S.Libner <sup>2</sup>	Ariane Group <sup>1</sup> RJ Industrie <sup>2</sup> (France)	Industrialization of Ariane 6 FSW welding benches
10h30 - 10h50	COFFE BREAK		
SESSION 2	APPLICATION 2 - ROOM 1 (Grand Amphi) Chair: Y. HOVANSKI		
10h50 - 11h10	L. Dubourg <sup>1</sup> , B.Bonneau <sup>1</sup> , P.Mognol <sup>2</sup> , Y. Macé <sup>2</sup>	Institut Maupertuis <sup>1</sup> ENS Rennes <sup>2</sup> (France)	FSW head for CNC machine tool: advantages, limitations and applications
11h10 - 11h30	D.Chartier, F.Darras	STELIA Aerospace (France)	Introduction of Friction Stir Welding on fuselage primary structures of aircrafts
11h30 - 11h50	M. Kahnert, D. Knerr, E. Wild, I. Tessier, N. Bour, G. Heinrich	MT Aerospace (Germany)	FSW Applications in the Frame of Ariane Launcher Programs at MT Aerospace
11h50 - 12h10	A. Meyer <sup>1</sup> , F.Ellermann <sup>2</sup>	RIFTEC GmbH <sup>1</sup> (Germany) HAI Hammerer Aluminium Industries GmbH <sup>2</sup> (Austria)	From small to large, thick to thin and sheet to cast – some of the daily challenges of a welding job-shop
12h10 - 12h30	J. De Backer, J.Martin	TWI (UK)	Improved Stationary Shoulder FSW performance through PVD and CVD Tool Coatings
12h30 – 13h00	Official opening – Local authorities		
13h00 - 14h20	LUNCH		

SESSION 3	CONTROL AND REPAIR - ROOM 1 (Grand Amphi) Chair: F. HENDRICKX			MODELLING – ROOM 2 (Amphi 1) Chair: L. FOURMENT		
14h20 - 14h40	<b>H.Robe</b>	TRA-C industrie (France)	Industrial experience feedback on the Friction Stir Welding of armored materials	<b>P.Lacki</b> <sup>1</sup> , K.Adamus <sup>1</sup> , T.Gańczyński <sup>2</sup>	Częstochowa University of Technology <sup>1</sup> PZL Mielec A Sikorsky Company <sup>2</sup> (Poland)	Impact of welding time on refill friction stir spot welds
14h40 - 15h00	<b>C.Leitao</b> <sup>1</sup> , M.I. Costa <sup>1</sup> , D.Gomes-Andrade <sup>2</sup> , D.M. Rodrigues <sup>1,2</sup>	CEMMPRE <sup>1</sup> ISISE <sup>2</sup> , University of Coimbra (Portugal)	Estimating temperature and weld quality based on torque sensitivity analysis	<b>S.Señorís</b> , R.Fernández, G.González-Doncel <sup>1</sup> , J.Ibáñez	Centro Nacional de Investigaciones Metalúrgicas, Madrid (Spain)	Separation of heat / deformation contributions in FSW welds of materials based aluminum alloys
15h00 - 15h20	<b>B.Strass</b> <sup>1</sup> , C.Conrad <sup>1</sup> , B.Wolter <sup>1</sup> , M.Thomä <sup>2</sup> , G.Wagner <sup>2</sup>	Fraunhofer Institute for Nondestructive Testing <sup>1</sup> Chemnitz University of Technology <sup>2</sup> (Germany)	Nondestructive Quality Inspection, Process Monitoring and Adaptation of Joint Properties in Friction Stir Welding	<b>H.Robe</b> <sup>1,2</sup> , C.Claudin <sup>2</sup> , J-M.Bergheau <sup>2</sup> , E.Feulvarch <sup>2</sup>	TRA-C industrie <sup>1</sup> ENISE <sup>2</sup> (France)	3D Thermo-mechanical Modelling of FSW Process with Complex Tool geometry and Experimental Validation
15h20 - 15h40	A.Silva-Magalhães <sup>1</sup> , <b>J.De Backer</b> <sup>2</sup> , J.Martin <sup>2</sup> , G.Bolmsjö <sup>1</sup>	University West <sup>1</sup> (Sweden) TWI <sup>2</sup> (UK)	Welding Temperature during FSW of 5 mm AA6082	<b>E.Hoyos</b> <sup>1</sup> , D.López <sup>2</sup> , H.Alvarez <sup>2</sup>	Universidad EIA <sup>1</sup> Universidad Nacional de Colombia <sup>2</sup> (Colombia)	Model based process window for FSW of AA7075-T6 joints

### 15h40 - 16h10 COFFEE BREAK

SESSION 4	PROCESS DEVELOPMENTS – ROOM 1 (Grand Amphi) Chair: J. GANDRA			ROBOTICS AND TECHNIQUES - ROOM 2 (Amphi 1) Chair: J. DE BACKER		
16h10 - 16h30	<b>G.J.Tchein</b> <sup>1</sup> , D.Jacquin <sup>1</sup> , E.Lacoste <sup>1</sup> , D.Coupar <sup>2</sup>	Univ. Bordeaux <sup>1</sup> Arts et Métiers ParisTech <sup>2</sup> (France)	Effect of pre-heat treatment on the microstructural characteristics of Ti-6Al-4V weld joints	<b>E.Arruti</b> , I.Quintana, E Aldanondo	IK4 Lortek (Spain)	Robotic Friction Stir Welding Lap Joints
16h30 - 16h50	<b>J.N.Aoh</b> , C.W.Huang, T.P.Huang, Y.C.Chang	National Chung Cheng University (Taiwan)	Friction Stir Additive Manufacturing (FSAM) of a T-Stringer Structure using Similar and Dissimilar Aluminum Alloys	<b>K. Kolegain</b> <sup>1</sup> , F.Leonard <sup>3</sup> , S.Zimmer-Chevret <sup>2</sup> , A.Ben Attar <sup>1</sup> , G.Abba <sup>3</sup>	Institut de Soudure <sup>1</sup> Arts et Métiers ParisTech <sup>2</sup> ENIM <sup>3</sup> (France)	Methodology for offline trajectory programming of three dimensional Robotic Friction Stir Welding
16h50 - 17h10	<b>T.C.Bor</b> , I.Nor Imrah Binti Yusoffa, H.J.M.Geijselaersa, R.Akkermana	University of Twente (Netherlands)	Solid state deposition of aluminium alloys employing friction surface cladding	<b>M.Guillo</b> , L.Dubourg	Institut Maupertuis (France)	Dual encoder robot for accurate Robotic Friction Stir Welding
17h10 - 17h30				<b>J. Goebel</b>	Helmholtz-Zentrum Geesthacht (Germany)	Semi-stationary shoulder BT-FSW in different Al-Li alloys

### SOCIAL EVENT : 17h50 – 23h30

#### Already included in the registration fees

17h50: Bus pick-up on the conference site (Arts et Metiers ParisTech, Campus of Metz, 4 rue Augustin Fresnel, 57070 Metz)

18h15: Bus stops in Metz city center

18h30-19h30: Guided tour of the city

19h30-23h30: Gala dinner in Metz city center

KEYNOTE 2		PLENARY - ROOM 1 (Grand Amphi) Chair: J. DOS SANTOS	
8h30 - 9h00	L.Fourment, A.Potet, S.Gastebois, K.Mocellin	MINES ParisTech CEMEF (France)	Numerical Modeling of Friction Stir (FSW) and Linear Friction (LFW) Welding Processes
SESSION 5		PLENARY - ROOM 1 (Grand Amphi) Chair: J. DOS SANTOS	
9h00 - 9h20	M.P.Miles <sup>1</sup> , C.Gunter <sup>1</sup> , C.Gygi <sup>1</sup> , F.Liu <sup>1</sup> , T.W.Nelson <sup>1</sup> , Y.Hovanski <sup>1</sup> , L.Fourment <sup>2</sup>	Brigham Young University <sup>1</sup> (USA), MINES ParisTech CEMEF <sup>2</sup> (France)	Friction stir processing for crack repair in 304L stainless steel
9h20 - 9h40	J.Liefeith, J.P.Bergmann	Technische Universität Ilmenau (Germany)	Underwater friction stir welding of arc welded carbon steel
9h40 - 10h00	F.Scandella	Institut de Soudure (France)	Friction-stir welding of high strength materials: a literature survey

### 10h00 - 10h20 COFFE BREAK

SESSION 6		FRICTION STIR PROCESSING - ROOM 1 (Grand Amphi) Chair: V.WAGNER		FRICTION STIR SPOT – ROOM 2 (Amphi 1) Chair: P. LACKI		
10h20 - 10h40	Y.Kimoto, T.Nagaoka, T.Takeuchi	Osaka Municipal Technical Research Institute (Japan)	Nanostructurization via FSP with ceramic and metallic additives	J.Adamus <sup>1</sup> , A.Derlatka <sup>1</sup> , G.Luty <sup>2</sup>	Czestochwowa University of Technology <sup>1</sup> PZL Mielec A Sikorsky Company <sup>2</sup> (Poland)	Impact of rotational speed of tool and time of sleeve plunging on quality of Refill Friction Stir Spot Welds
10h40 - 11h00	J.N.Aoh <sup>1,2</sup> , C.W.Huang <sup>1,2</sup>	AIMHI <sup>1</sup> , Department of Mechanical Engineering <sup>2</sup> , National Chung Cheng University (Taiwan)	Texture of a Friction Stir Zone of Al6061 containing Copper-coated SiC Particulate Reinforcement	B.Fu, J.Shen, A.C. Pereira, U.F.H. Suhuddin, J.F.Dos Santos	Helmholtz-Zentrum Geesthacht (Germany)	Microstructure and mechanical properties of friction spot welds of AZ31 magnesium alloy to galvanized steel
11h00 - 11h20	J.G.Santos Macías <sup>1</sup> , B.Van Hooreweder <sup>2</sup> , E.Maire <sup>3</sup> , J.Adrien <sup>3</sup> , P.Jacques <sup>1</sup> , A.Simar <sup>1</sup>	Université catholique de Louvain <sup>1</sup> KU Leuven <sup>2</sup> (Belgium) INSA Lyon <sup>3</sup> (France)	Friction stir processing of additive manufactured AlSi10Mg parts to improve mechanical behaviour	J.Andres, T.Gałączyński, G.Luty, A.Wrońska	PZL Mielec A Sikorsky Company (Poland)	Effect of RFSSW process parameters on lap joints quality of thin aluminum 7075 T6 sheets
11h20 - 11h40	M.Alvarez-leal <sup>1</sup> , F.Carreño <sup>1</sup> , A.Orozco-Caballero <sup>2</sup> , O.A.Ruanoa <sup>1</sup>	CENIM-CSIC <sup>1</sup> (Spain) University of Manchester <sup>2</sup> (UK)	Improvement of mechanical properties after Friction Stir Processing of a magnesium-rare earth alloy	H.Su, J. Shen, U.F.H. Suhuddin, B. Fu, J.F. Dos Santos	Helmholtz-Zentrum Geesthacht (Germany)	Numerical simulation of the temperature distribution in refilled friction spot welding
11h40 - 12h00	A. Zens <sup>1</sup> , M.Gnedel <sup>2</sup> , M.F.Zaeh <sup>1</sup> , F.Haider <sup>2</sup>	Technical University of Munich <sup>1</sup> University of Augsburg <sup>2</sup> (Germany)	Mechanical Alloying via Friction Stir Processing	A.Regensburg, F.Petzoldt, T.Benß, T.Köhler, J.P.Bergmann	Technische Universität Ilmenau (Germany)	Solid-liquid interdiffusion during Friction Stir Spot Welding of EN AW 1070 / EN CW 004A dissimilar joints
12h00 - 12h20	F.Hannard <sup>1</sup> , S. Castin <sup>1</sup> , E. Maire <sup>2</sup> , R.Mokso <sup>3,4</sup> , T.Pardoën <sup>1</sup> , A.Simar <sup>1</sup>	Université catholique de Louvain <sup>1</sup> (Belgium) INSA-Lyon <sup>2</sup> (France) Swiss Light Source <sup>3</sup> , (Switzerland) MAX-lab <sup>4</sup> (Sweden)	Ductilization of aluminium alloy 6056 by friction stir processing	M.Reimann, J.F.Dos Santos	Helmholtz-Zentrum Geesthacht (Germany)	Keyhole repair in aluminium alloys using refill friction stir spot welding

### 12h20 - 14h40 LUNCH AND VISITS

SESSION 7		MICROSTRUCTURE AND DISSIMILAR 1 - ROOM 1 (Grand Amphi) Chair: A. SIMAR	
14h40 - 15h00	D.Verdera <sup>1</sup> , C.Llovo <sup>1</sup> , S.Señorís <sup>2</sup> , R.Fernández <sup>2</sup> , G.González Doncel <sup>2</sup>	AIMEN <sup>1</sup> CENIM <sup>2</sup> (Spain)	Dissimilar friction stir welding between a highly reinforced composite (AA6061-40%SiC) and a monolithic AA6061-T6 aluminium alloy.
15h00 - 15h20	M.-N.Aveitand-Fenoel <sup>1</sup> , T.Nagaoka <sup>2</sup> , H.Fujii <sup>3</sup> , R.Taillard <sup>1</sup>	UMET <sup>1</sup> (France) Osaka Municipal Technical Research Institute <sup>2</sup> Osaka University <sup>3</sup> (Japan)	Refractory dissimilar friction stir welding of steel and WC/Co cermet
15h20 - 15h40	C.P. Cheng <sup>1</sup> Y.S. You <sup>1</sup> , C.J. Wang <sup>2</sup> , H.C. Liang <sup>2</sup> , W.C. Cheng <sup>2</sup>	National Taiwan Normal University <sup>1</sup> , National Taiwan University of Science and Technology <sup>2</sup> (Taiwan)	Microstructure and Mechanical properties of Friction Stir welding on Dissimilar Inconel alloy and Stainless Steel

15h40 - 16h00 COFFEE BREAK

SESSION 8		MICROSTRUCTURE AND DISSIMILAR 2 - ROOM 1 (Grand Amphi) Chair: M.N. AVEITAND-FENOEL	
16h00 - 16h20	R.Bertrand <sup>1,2</sup> , D.Texier <sup>2</sup> , H.Robe <sup>1,3</sup> , Y.Zedan <sup>2</sup> , E.Feulvarch <sup>2</sup> , P.Bocher <sup>1</sup>	ENISE <sup>1</sup> (France) École de technologie supérieure, Québec <sup>2</sup> (Canada) TRA-C industrie <sup>3</sup> (France)	Heterogeneous mechanical behavior of dissimilar FSWed joints assessed by OHR-DIC characterizations
16h20 - 16h40	I.Quintana, E.ARRUTI, E.Aldanondo	IK4 Lortek (Spain)	Effects of sealants, tool design and welding parameters on the properties of dissimilar magnesium/aluminum friction stir welded lap joints
16h40 - 17h00	M.N.Ilman, F.X.A.Wahyudianto, M.Bayujaji	Universitas Gadjah Mada (Indonesia)	Static, Fatigue and Corrosion Behaviours of AA6061-T6/AA5083-H116 Dissimilar Metal Friction Stir Welded Joints
17h00 - 17h20	Y.Hovanski <sup>1</sup> , P.Upadhyay <sup>2</sup> , E.Boettcher <sup>3</sup>	Brigham Young University <sup>1</sup> Pacific Northwest National Laboratory <sup>2</sup> (USA)	Joining Aluminum to Steel with Friction Stir Scribe
17h20 - 17h40	N. Manuel <sup>1,2</sup> , J. M.Costa <sup>1</sup> , A.Loureiro <sup>1</sup>	CEMUC <sup>1</sup> (Portugal) Escola Superior Politecnica do Namibe <sup>2</sup> (Angola)	Effect of material properties on quality of FSW dissimilar T-joints

17h40 - 17h50 CLOSING

**OPTIONAL – INDUSTRIAL VISIT TO INSTITUT DE SOUDURE FACILITIES**  
**LIMITED NUMBER OF PLACES – ONLY FOR PEOPLE WHO REGISTERED EARLY ON THE WEBSITE**

**7h45 : Bus pick-up on the conference site (Arts et Metiers ParisTech, Campus of Metz, 4 rue Augustin Fresnel, 57070 Metz)**

**POSTERS SESSION**

Author(s)	Affiliation	Title
N. Manuel <sup>1,2</sup> , J. M.Costa <sup>1</sup> , A.Loureiro <sup>1</sup>	CEMUC <sup>1</sup> (Portugal) Escola Superior Politecnica do Namibe <sup>2</sup> (Angola)	Effect of material properties on quality of FSW dissimilar T-joints
J. Andres, T.Gataczyński, G.Luty, A.Wrońska	PZL Mielec A Sikorsky Company (Poland)	FSW joining of thin aluminum 7075 T6 sheets
J.N.Aoh, C.W.Huang	National Chung Cheng University (Taiwan)	Texture of a Friction Stir Zone of Al6061 containing Copper-coated SiC Particulate Reinforcement
V.S.M. Magalhães, C. Leitão, D.M.Rodrigues	University of Coimbra (Portugal)	An overview on Friction Stir Welding technology research, development and industrial implementation
R.Chamorro, A.L.Serp	University of Campinas (Brazil)	Fault detection using the Fast Fourier Transform spectrogram of the tool forces and spindle torque in a FSW process
P. Lacki <sup>1</sup> , J.Winowiecka <sup>1</sup> , T.Gataczyński <sup>2</sup>	Częstochowa University of Technology <sup>1</sup> PZL Mielec A Sikorsky Company <sup>2</sup> (Poland)	Optimization of Friction Stir Welding process parameters for aluminum alloys
P.De Sousa Santos <sup>1,2</sup> , A.Robelou <sup>1</sup> , J.Gandra <sup>1</sup> , X.Zhang <sup>2</sup>	TW <sup>1</sup> Coventry University <sup>2</sup> (UK)	The effects of refill friction stir spot welding AA6016-T4 to DP600 GI joints in the presence of automotive structural adhesive
R.Acuña <sup>1</sup> , M.J.Cristóbal <sup>1</sup> , M. Cabeza <sup>1</sup> , D.Verdera <sup>2</sup>	University of Vigo <sup>1</sup> AIMEN <sup>2</sup> (Spain)	Fabrication of surface metal matrix composite via friction stir processing (FSP) on aluminium alloys: wear behavior



## PARTNERS AND SPONSORS



For more than 45 years **FPT INDUSTRIE S.p.A.** has been manufacturing CNC milling and boring machines for the mechanical and die & mould fields. During the latest 10 years, FPT INDUSTRIE S.p.A. has developed a branch with the task of researching and developing complete machinery

for FSW. We take care of our customer directly, from the first approach, to the development of the machineries, the manufacture, the installation and finally the service for the entire life of our products. The worldwide experience made since 1969 on the production of thousands of big-sized milling machines, heads, software and clamping methods, made us, in the latest years, the most innovative and complete player on manufacturing of big-sized machineries for FSW with a continuous development of our systems, thanks also to the relationships and the experiences made with our customers

## SPONSORS



**PRECILOR** specializes in the machining of complex materials and superalloys. A motivated team and the constant evolution of our means of production and control allow us to master materials such as: INCONEL (600, 625 et 718) ; TITANE TA6V ; CUPRO ALU, CUPRO NICKEL HASTELLOY.

Technical skills : mechanical study, electrical and automated study, programming in 3D file machining, machining, assembly, FSW tools, wiring, commissioning on site, after sales service

Activity Area : AUTOMOTIVE, PRETROL SEARCH, ENERGY, COSMETIC, SIDERURGY, WIRING, AERONAUTICS, PLASTICS, LABORATORY TESTS.



**TRA-C INDUSTRIE** - CREATE THE INDUSTRIAL INNOVATION  
Sector: Manufacturing and Industrial services

Industry: Mechanical engineering and manufacturing

**TRA-C industrie**, a French owned company since 2001, is a European leader in the metalworking definition, manufacture and installation with our innovative Friction Stir

Welding (FSW). As the 1st company in France to have developed FSW for serial production, TRA-C industrie possesses FSW machines (small-sized 30 kN and big-sized 100 kN capacity) for R&D activities and manufacturing big parts. With first-mover advantages, we provide research and development, manufacturing machines and sub-contracting projects using high-tech FSW for customers' demands. Our core businesses: Engineering & Production Solutions, Friction Stir Welding and Training and Technical Assistance.