4D HYBRID

Newsletter n°3

www.4Dhybrid.eu

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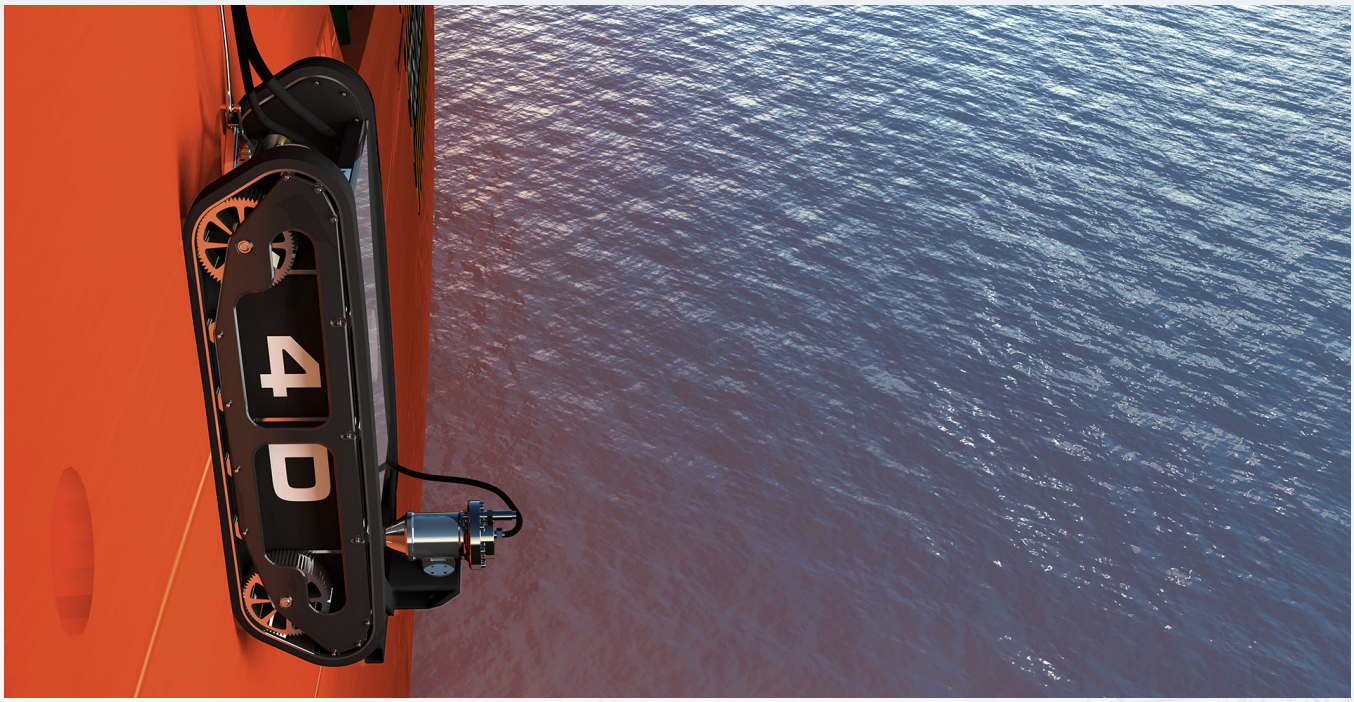
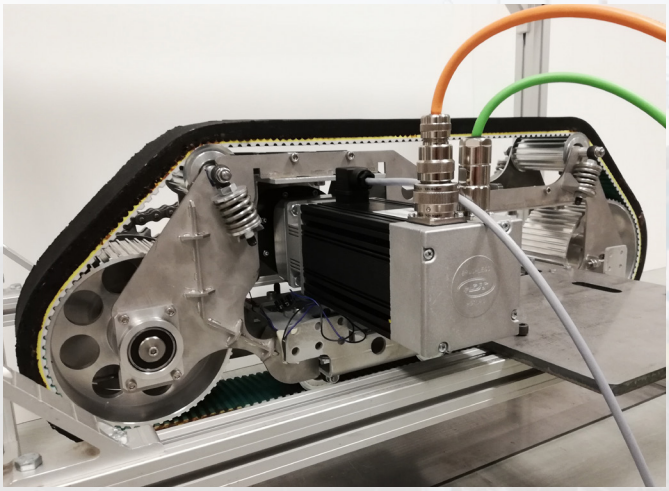
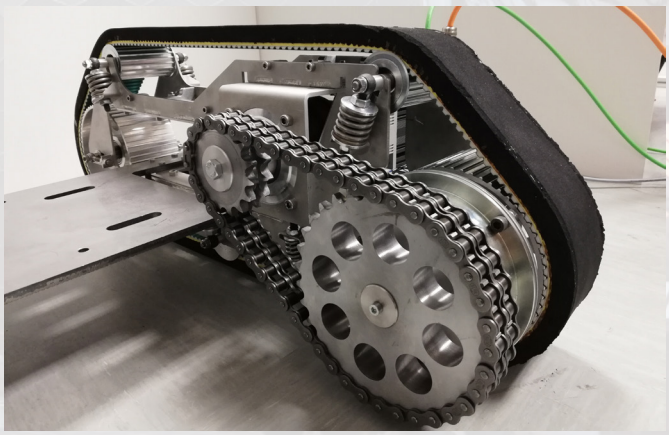
The 4D Hybrid Autonomous robot

During the first two years of the project the 4D Hybrid Autonomous robot has been developed, to perform detection and reparation of metal vertical surfaces in offshore environments. In order to do that, a 3D Scanner and a Cold Spray gun have been integrated on it. The 3D scanner implemented for the mobile platform is an Artec Space Spider commercial scanner able to reconstruct the surface and individuate the corrosion/defect on the metal surface. The Cold Spray system instead is the 4D Hybrid module designed during the project by SUPSI. It is used to deposit new metal coating on the surface; the coating can be realized in both stainless steel or aluminum alloys.

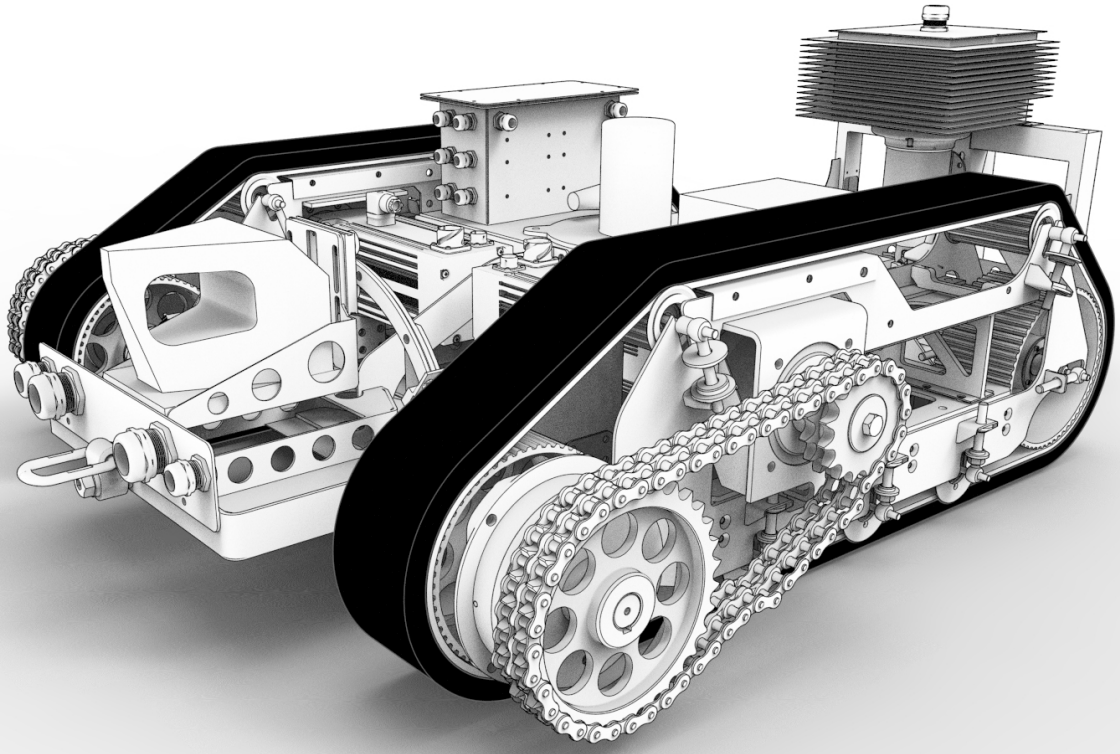






In order to be able to climb vertically the extremely slippery surfaces the robot has been designed as a tracked vehicle, equipped with two robust rubber belts which are keep in contact with the surface thanks to a powerful vacuum-based adhesion system, placed at the center of it. The two aforementioned rubber tracks allow the robot to move on the metal surfaces with two different degrees of freedom; it can goes back/forth and rotate, even on its main axis.

While performing Cold Spray based processes in open environments the implementation of specific recovery strategies for the dispersed powder becomes fundamental. In order to avoid such dispersion the robot is equipped with a powder recovery system that sucks up the powders and carries them until the top of the ship. The Autonomous robot is designed in order to work with different conditions of the metal surfaces; corroded, not corroded, in presence of water and dirt and with an environmental temperature ranging between 3 to 35°C.



Achieved results

Work Package 2

Industrial scenarios and requirement definition ✓
Design of RR part ✓
4D engineering Platform ✓

Work Package 3

Deposition and ablation processes for RR part and CAx chain ✓
Closed loop process simulation and adaptation strategies ✓
Regenerative CAx chain ✓

Work Package 4

Development and optimization of laser sources ✓
Design and optimization 3D scanner and optical chain ✓
Design of powder and Cold Spray modules ✓

Work Package 5

Design of process-equipment sensing system ✓
Design of vision system SW architecture ✓
High speed data fusion ✓
3D model acquisition ✓

Some Partners:

RAMTEID

General Information

Ramteid GmbH is a German technology provider of expert vision system hardware and software and acts for many years in the field of industrial, scientific and medical image processing. Ramteid combines the competence of software engineering and project management in one hand for the benefit of its customers and projects.

With 20 years of experience and core competences in high performance vision systems, industrial quality inspection as well as 3D vision & modelling Ramteid provides intelligent software solutions for customers and EU research projects.

As expert in the design and implementation of complex software solutions and vision systems, Ramteid stands out with its profound expertise, emphasizing on flexible and customer tailored solutions.

Role in 4D Hybrid

The main role of Ramteid in 4DHybrid is the design of a vision and sensing system for monitoring activities, including the selection of vision system hardware equipment as well as design and implementation of software solutions with complex 2D/3D image analysis.

The hardware consists of several high-resolution cameras, thermal cameras and a 3D infrared scanner. Based on the requirements of fast data processing and data reduction, the cameras responsible for 2D image analysis within the system are equipped with processing capabilities provided by a SoC-FPGA (System on Chip Field Programmable Gate Array) for processing most of the captured image data directly on the camera itself and interconnecting with other system sensors by efficiently transferring processing data. SoC-FPGA devices integrate both processor and FPGA architectures into a single device, ideal for timing critical and high-performance embedded vision systems. The physical 4D Hybrid inspection devices are built in Ramteid labs and integrated in the user platforms.
Ramteid contributes the entire software component of the scanning device consisting of 4D embedded scanning algorithms, complex 3D metallurgic surface analysis and defects detection, which is tested by prototypes.

Ramteid is involved into processing data from sensing systems to CAD representation as well. Data from the vision system, especially the extracted geometric features, contributes to build a real-time geometry of the in-progress product, enhances the CAD model with additional information content and injects this feature data into the online CAx infrastructure.

KOORD Sàrl

KOORD develops electronic boards for the control of electric motors for output power ranging from 1W to 2KW. These circuits are designed to be installed in small electromechanical devices, machines, or technical equipment.

KOORD products are distinguished by the following unique features:

- MFF (Motor Fingerprinting Functions)
- Continuous motor health monitoring
- Plug & play installation
- IOT interface and online data analysis
- Complete customization of the system (software and hardware)
- Operation mode: autonomous / dependent
- Suited for prototypes and larger industrial series
- Optimized cost

In addition, KOORD offers a complete customer support service:

- Support for the system integration and setup
- Support for the development of complete systems or mechatronic units

Advanced Characterization Functions

KOORD has developed its Motor Fingerprinting Functions (MFFs), built around its algorithms for the automatic characterization of electric motors without external sensors. MFFs uses predictive analysis to detect any potential problem, adjust the control parameters, activate alarms, initiate safety procedures, or initiate reduced or degraded operation mode.

IOT Gateway

The data monitored by the KOORD electronic boards can be, when requested, sent to a server, for a continuous and in-depth analysis. This enables additional identification functions for problems occurring over a long test duration, or a continuous remote optimisation and parametrisation. Regular reports on the state of the system can also be automatically generated.

Customization

Upon request, KOORD integrates custom functions (Hardware or Software) to meet the most stringent customer requirements. KOORD can also validate the design to obtain industrial certifications.

Master / Slave Function

KOORD electronic units can control the complete mechatronic device (LCD, sensors, ...) or be integrated to work with a third-party master unit.

Engineering Services

KOORD engineering team is in direct contact with the customer to support in the selection and dimensioning of components, the definition of control strategies and for product optimization. Upon request, KOORD also develops complete mechatronic systems.

POLITECNICO DI TORINO

Politecnico di Torino, founded in 1906 from the roots of the Technical School for Engineers created in 1859, has a long-standing tradition of leadership of technical culture. It is one of the most important universities in Europe for engineering and architecture studies, strongly committed to collaboration with industry. Politecnico di Torino offers excellence in technology and promotes the ability to carry out theoretical or applied research and also the capacity to achieve concrete and reliable productive processes or organize services and facilities. The range of studies is broad and ever-widening since it spans space, environment and land, telecommunications, information, energy, mechanics, electronics, chemistry, automation, industrial design, architecture and building. Politecnico di Torino has close relationships with international institutions, companies, local government and other types of associations; with more than 150 bilateral international agreements and 40 double degree agreements, Politecnico di Torino has links with the most prestigious Universities in Europe. Two department are involved in 4DHYBRID project:

Department of Applied Science and Technology (DISAT)

DISAT focuses on research and education involving the fundamental principles of matter and energy, their transformation and related engineering applications. It does so throughout a wide and complementary range of disciplines: physics of condensed matter and fundamental interactions, nanotechnology, chemistry, materials science, metallurgy, actively pursuing chemical, physical, materials and food engineering spanning from the conception of new processes, to the development of new chemical reactors and process units by modelling and experimental tools, from the optimisation of control strategies and devices to the design of pilot and industrial-scale plants.

The Materials Science and Engineering for Innovative Technologies (SIMTI) research team at DISAT has specific skills in basic research with technological development and pre-industrial innovative materials as well as it pursues the development of a robust and competitive approach to the complexity of the functions and properties required of new materials and overbearing affirmation of the new manufacturing technologies.

Department of Management and Production Engineering (DIGEP)

DIGEP is the point of reference in Politecnico di Torino for the areas of knowledge that study the relationship between systems of production of goods and services and the economic environment in which they operate, thus blending engineering approaches with economics and management. DIGEP promotes, coordinates and manages basic and applied research, training, technology transfer and services to the local community in the areas of systems of production, quality management, product design, management and accounting, industrial plants law and economics.

The Advanced Manufacturing Technologies (AMTECH) research team at DIGEP has specific skills in computer-aided design, process simulation and manufacturing; especially in the areas of Additive Manufacturing (AM), Computer Aided Engineering (CAE), Reverse Engineering (RE) and Computer Aided Manufacturing (CAM). Our research activities are focused on the application of additive techniques and thus on the analysis of existing processes in terms of process optimization, part quality improvement and new applications or future perspectives from the point of view of final users and new adopters of additive technologies.

Interdepartmental Centre on Integrated Additive Manufacturing (IAM@PoliTo)

IAM@PoliTo is a multidisciplinary Additive Manufacturing research platform with the aim of dealing with and overcoming the open challenges, in terms of machines, materials and applications, and of contributing, together with other industrial actors, in the development of new generation systems destined for final production from the Industry 4.0 viewpoint. The expertise and collaboration of the DISAT and DIGEP research groups is an element of distinction and excellence of the IAM@PoliTo Centre, which covers all the engineering activities related to material development, product and process design, process optimization, part fabrication and finishing.

Technology Transfer System

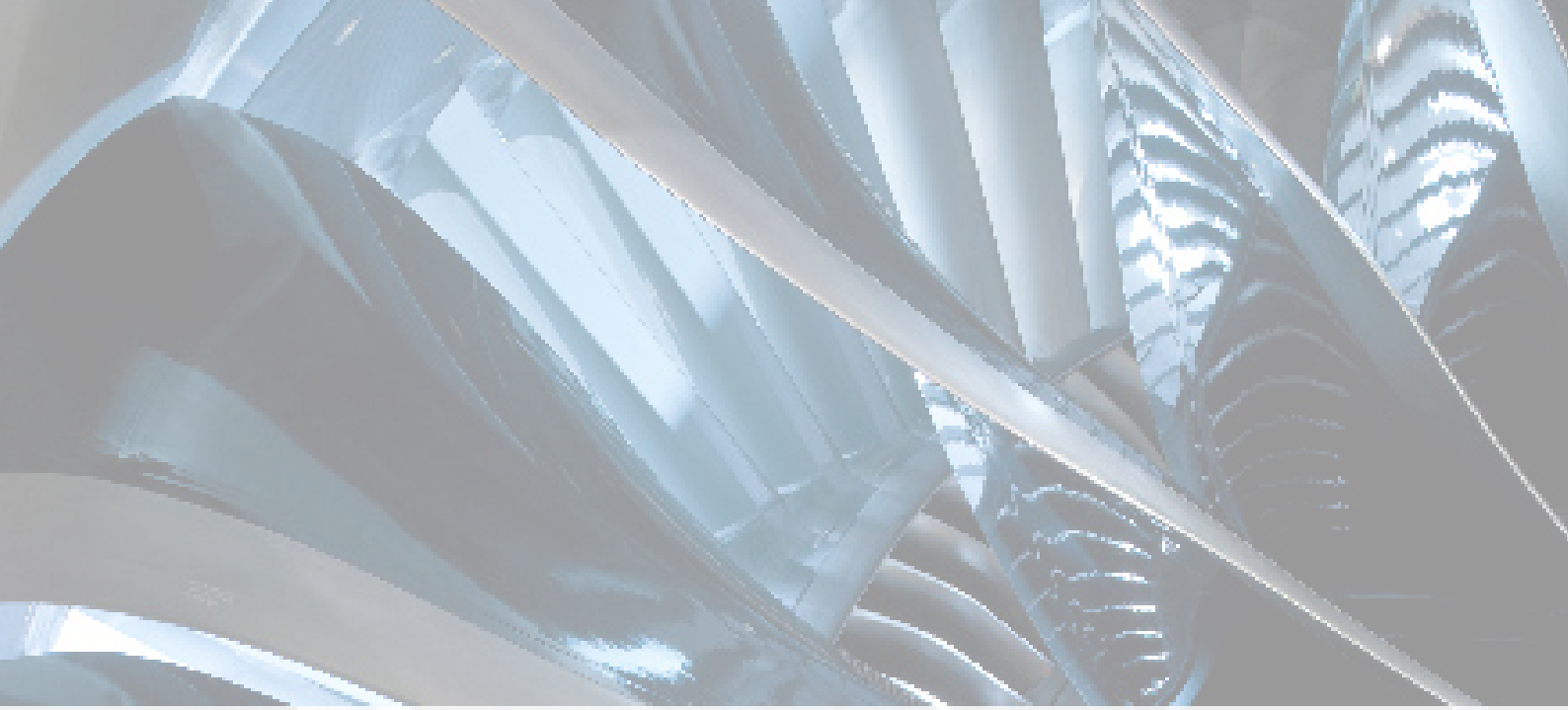
Technology Transfer System S.r.l. was founded in 1993 as a spin-off of an Italian research institute on industrial technologies and automation with the goal to develop and deploy IT solutions to the manufacturing industry. Nowadays the company has ten employees with background in informatics, mechanical and management engineering, and it is primarily focused in the development of cutting-edge simulation solutions supporting strategic, tactical and operational decision making in manufacturing companies. The available competences refer to Industry 4.0 key concepts, where the virtual world and the physical world converge for more effective and sustainable production. In this context, TTS:

- develops proprietary libraries and software solutions enabling the accurate and reliable virtualization of manufacturing technologies and processes, and their synchronization with their physical counterparts, thus enabling value-adding decision making all along the machine/plant lifecycle implementing the Digital Twin concept seamlessly to any kind of manufacturing technologies;
- applies its competences for the development of ad-hoc software solutions intended for efficient and sustainability-aware decision making within manufacturing contexts. This results in both stand-alone and integrated software modules and platforms advising for the most efficient and environment-aware production choices or socially conscious manufacturing approaches e.g. through balanced job assignments;
- has strong software development competences and complete ownership of its FIWARE-compliant connectors and simulation software solutions, a set of libraries for the digitalization of complex and CPS-based manufacturing environments, designed to be easily integrated in composite solutions suited to the specific application needs.

To exploit and foster its network of competences, TTS is also member of EFFRA (“European Factories of the Future Research Association”), where the company stands as reference for “simulation and forecasting technologies” and challenges the identification and future development road-mapping on the topic.
Two are the objects TTS develops within 4DHybrid:

- the Metal deposition simulation module, a software version of a properly developed algorithm used for the generation of piece geometry. This algorithm allows to simulate the deposition of material performed by an additive manufacturing machine in a 3D space.
- the Simulation-NC connector, a connector between the PLC and the TTS Simulation tool for a 5-axis machine.

Those modules strengthen the position TTS has in the simulation arena, where the physical and real world converge towards I4.0 full implementation in manufacturing.



Project Coordinator

Prima Electro
electronics and laser technologies

Technical Coordinator

SUPSI

Project Partners

COMAU

Keen Bull

3D-NT
ADDITIVE TECHNOLOGIES

Technology Transfer System

Prima Power

RAMTEID

LMS
Laboratory for Manufacturing Systems & Automation

mci

IRIS
Playground for new Ideas

ITI
International TechneGroup

OPTOMEC
Production Grade 3D Printers... with a Material Difference

UNIVERSITY OF BIRMINGHAM

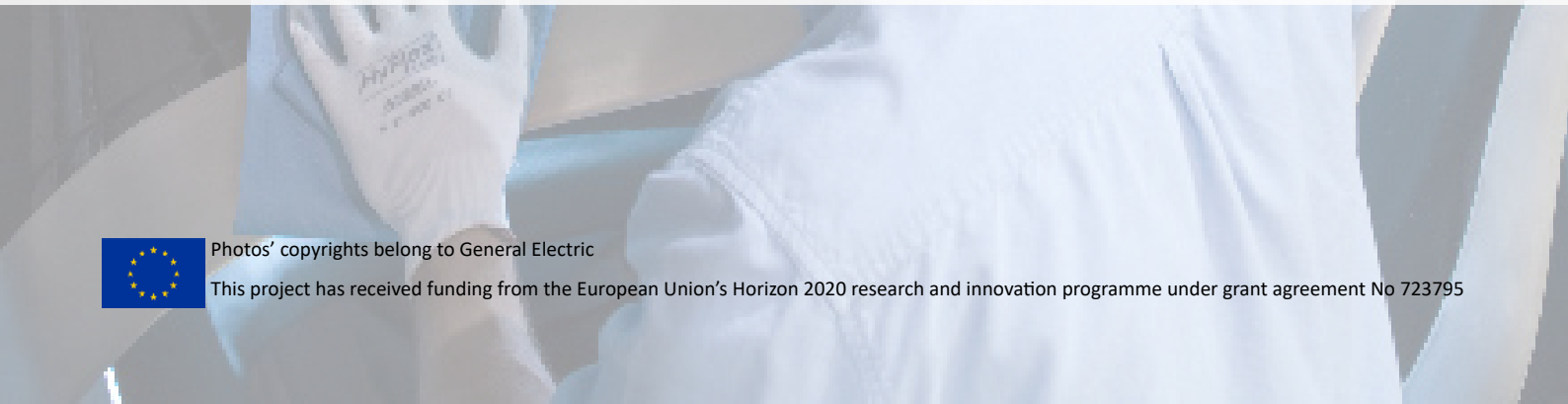
KOORD Sàrl

GE Aviation

POLITECNICO DI TORINO

CSIR
our future through science

SIEMENS



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