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**MAIN GAP**

# APLICACIONES Y TENDENCIA EN LOS SECTORES DE AUTOMOCIÓN Y AERONÁUTICA

BOLETÍN DE VIGILANCIA TECNOLÓGICA.  
2019. CTAG

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## SECCIÓN I. REALIDAD AUMENTADA Y VIRTUAL

### NOTICIAS

#### AUTOMOCIÓN

12/03/2019

##### VR for the Automotive Industry: PSA use cases & benefits

Immersive Learning is nothing but the name of a proper revolution to be reckoned with. Based on the most powerful levers for efficient and engaging learning, now strongly evidenced by scientific research, Immersive Learning is paving the way for a great deal of value creation at organizations that have seized the related opportunities. The PSA Group, a leader in the automotive industry, is one of them. Let's see how PSA has engaged in a journey towards better training and communication through the use of Virtual Reality and Immersive Learning.



<https://www.uptale.io/en/vr-for-the-automotive-industry-psa-use-cases-benefits/>

10/07/2019

##### BMW Drive New Roads with VR and AR

The BMW Group Production focuses increasingly on trendsetting, easy-to-use and effective virtual (VR) and augmented (AR) reality applications. VR images, or artificially created images, are ever more realistic and harder to distinguish from real pictures. In AR applications, illustrations complement real images. AR and VR images can be viewed in special headsets or on normal tablet computers. In production, these images are powerful tools in numerous use cases in training and qualification, planning of workstations at the assembly line, or quality control.



<https://metrology.news/bmw-drive-new-roads-with-virtual-and-augmented-reality/>

16/08/2019

##### Audi Virtually Tests Assembly Processes

Audi is embracing virtual reality (VR) with the Audi e-tron GT. Using VR glasses and controllers, employees from various departments test all assembly processes entirely virtually. Audi has developed in-house its virtual reality software for the process. This relies on 360-degree scans that provide a three-dimensional indoor map for the virtual space. The technology is being used for the first time for testing the assembly processes for the e-tron GT at the Neckarsulm site. This is the first time that workflows along the assembly line and



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the associated logistics processes are being tested entirely virtually in the “3P workshops”.

<https://metrology.news/audi-virtually-tests-assembly-processes/>

### **AERONÁUTICA**

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11/02/2019

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#### **Airbus apuesta por la realidad virtual en el mantenimiento de aviones**

El constructor aeronáutico europeo Airbus ha apostado por entrar en el mundo virtual para mejorar el mantenimiento de los aviones, implementando tecnologías de realidad virtual y aumentada en la industria, a través del empleo de herramientas de software VR en todo el proceso de diseño de la aeronave, así como en el taller digital y con fines de inspección. Durante las fases de diseño y desarrollo de un avión y cuando se implementan modificaciones o actualizaciones, los ingenieros de Airbus deben verificar y mejorar la viabilidad de las actividades de mantenimiento relacionadas.



<https://actualidad aeroespacial.com/25879-2/>

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04/07/2019

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#### **Airbus lleva el MRO al 4.0, mediante drones, IA y realidad aumentada**

El MRO -mantenimiento, reparación y overhaul-, más conocido simplemente como mantenimiento aeronáutico, contará con un nuevo sistema, presentado por AIRBUS en la Feria FEINDEF, que realiza las inspecciones mediante un dron acompañado de un equipo de inteligencia artificial (IA) y realidad aumentada. Todo ello permite reducir el tiempo que un avión está parado en tierra por mantenimiento. La propuesta consiste en reemplazar la revisión ocular de aeronaves por una asistida por drones y en poder desarrollar el análisis de la información y toma de decisiones mediante inteligencia artificial y realidad aumentada.



<http://www.hispaviacion.es/airbus-lleva-mro-al-4-0-mediante-drones-ia-realidad-aumentada/>

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13/08/2019

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#### **How Lockheed Martin is Using Augmented Reality in Aerospace Manufacturing**

Lockheed Martin is famous for engineering innovation, dating back to the legendary Skunkworks. Today, the defense contractor is making use of innovative augmented reality technology in their manufacturing process and across entire product lifecycles. Lockheed Martin’s AR project began in the Space Systems division, for example in assembly and quality processes for NASA’s Orion Spacecraft, but has been so successful that the company has deployed the Microsoft HoloLens hardware and Scope AR software



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in other divisions, namely Aeronautics, Missiles and Fire Control, and Rotary and Mission Systems.

<https://www.engineering.com/AdvancedManufacturing/ArticleID/19450/How-Lockheed-Martin-is-Using-Augmented-Reality-in-Aerospace-Manufacturing.aspx>

## PUBLICACIONES CIENTÍFICAS

### AUTOMOCIÓN

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Febrero/2019

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#### **Augmented reality technology in the manufacturing industry: A review of the last decade**

*Eleonora Bottani, Giuseppe Vignali*

The aim of this article is to analyse and review the scientific literature relating to the application of Augmented Reality (AR) technology in industry. AR technology is becoming increasingly diffuse, due to the ease of application development and the widespread use of hardware devices (mainly smartphones and tablets) able to support its adoption. Today, a growing number of applications based on AR solutions are being developed for industrial purposes. Although these applications are often little more than experimental prototypes, AR technology is proving highly flexible and is showing great potential in numerous areas (e.g., maintenance, training/learning, assembly or product design) and in industrial sectors (e.g., the automotive, aircraft or manufacturing industries). It is expected that AR systems will become even more widespread in the near future.

<https://www.tandfonline.com/doi/full/10.1080/24725854.2018.1493244>

Mayo/2019

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#### **Augmented Reality in Intralogistics Planning of the Automotive Industry: State of the Art and Practical Recommendations for Applications**

*Anke Rohacz, Steffen Strassburger*

This article investigates Augmented Reality (AR) as a potential tool to support intralogistics planning in the automotive industry. Starting with a literature review and an investigation of the dissemination of AR usage in logistics in general, we analyse potential reasons for the apparent lack of AR applications in intralogistics planning. From this, we derive requirements for a successful application of AR in intralogistics planning and demonstrate a prototypical solution implemented within the Daimler AG. Based on this example, we further discuss the advantages of applying AR to intralogistics planning.

<https://ieeexplore.ieee.org/abstract/document/8714848>

Julio/2019

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#### **Training Assistant for Automotive Engineering Through Science Case Study**

*Fernando R. Pusda, Francisco F. Valencia, Víctor H. Andaluz, Víctor D. Zambrano*

This article proposes the development of an augmented reality application for mobile devices with Android OS focused on the visualization and interaction of the user with the components, technical characteristics, location and the processes of disassembly and assembly of engine in a vehicle; facilitating the learning process referring to this automotive system. The application was developed in the graphic engine 3D Unity and the use of Vuforia for the



recognition of objects in 3D, being a technological tool that allows vouching the learning in the internal combustion engine, guiding the user and changing the paradigms of the use of physical manuals with the new technological advances as the augmented reality.

[https://link.springer.com/chapter/10.1007/978-3-030-25999-0\\_13](https://link.springer.com/chapter/10.1007/978-3-030-25999-0_13)

## AERONÁUTICA

Febrero/2019

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### Maintenance in aeronautics in an Industry 4.0 context: The role of Augmented Reality and Additive Manufacturing

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*Alessandro Ceruti, Pier Marzocca, Alfredo Marzocca, Alfredo Liverani, Cees Bil*

The paper broadly addresses how Industry 4.0 program drivers will impact maintenance in aviation. Specifically, Industry 4.0 practices most suitable to aeronautical maintenance are selected, and a detailed exposure is provided. Advantages and open issues are widely discussed and case studies dealing with realistic scenarios are illustrated to support what has been proposed by authors. The attention has been oriented towards Augmented Reality and Additive Manufacturing technologies, which can support maintenance tasks and spare parts production, respectively. The intention is to demonstrate that Augmented Reality and Additive Manufacturing are viable tools in aviation maintenance, and while a strong effort is necessary to develop an appropriate regulatory framework, mandatory before the widespread introduction of these technologies in the aerospace systems maintenance process, there has been a great interest and pull from the industry sector.

<https://academic.oup.com/jcde/article/6/4/516/5732347>

Octubre/2019

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### Review of augmented reality in aerospace industry

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*Maryam Safi, Joon Chung, Pratik Pradhan*

The purpose of this paper is to assess and determine the potential of augmented reality (AR) in aerospace applications through a survey of published sources. This paper reviews a database of AR applications developed for the aerospace sector in academic research or industrial training and operations. The review process begins with the classification of these applications, followed by a brief discussion on the implications of AR technology in each category. This paper is a general review introducing existing and potential AR applications in various fields of the aerospace industry. Unlike previous publications, this article summarizes existing and emerging applications to familiarize readers with AR use in all of aerospace. The paper outlines example projects and creates a single comprehensive reference of AR advancements and its use in the aerospace industry. The paper provides individuals with a quick guide to available and emerging technology.

<https://www.emerald.com/insight/content/doi/10.1108/AEAT-09-2018-0241/full/html>



## SECCIÓN II. FABRICACIÓN ADITIVA

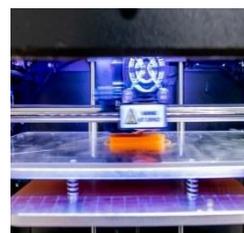
### NOTICIAS

#### AUTOMOCIÓN

26/04/2019

##### **Audi amplía el uso de la impresión 3D en el proceso de producción**

The BMW Group Production focuses increasingly on trendsetting, easy-to-use and effective virtual (VR) and augmented (AR) reality applications. VR images, or artificially created images, are ever more realistic and harder to distinguish from real pictures. In AR applications, illustrations complement real images. AR and VR images can be viewed in special headsets or on normal tablet computers. In production, these images are powerful tools in numerous use cases in training and qualification, planning of workstations at the assembly line, or quality control.



<http://www.auto-revista.com/texto-diario/mostrar/1545589/audi-amplia-impresion-3d-proceso-produccion>

11/12/2019

##### **BMW takes additive manufacturing from prototype to serial lines**

Last year BMW announced that over the previous decade it had produced 1m additively manufactured parts for prototyping, tooling and in-vehicle part applications in both polymer and metal materials, with one fifth of that total over just the previous 12 months. The additive manufacturing team at the BMW Group Research and Innovation Centre now processes annually almost 30,000 prototype orders and delivers over 200,000 components.



<https://www.automotivemanufacturingsolutions.com/additive/3d-printing/bmw-takes-additive-manufacturing-from-prototype-to-serial-lines/39753.article>

#### AERONÁUTICA

12/02/2019

##### **Liebherr starts serial production of 3D printed components for Airbus**

Liebherr-Aerospace has started 3D printing components for Airbus. Following approval from the European aircraft manufacturer, first equipment fit for flight that Liebherr will be supplying will be nose landing gear brackets for the Airbus A350 XWB. Liebherr has collaborated with Airbus over the past few years and development of additive manufacturing is advancing at a fast pace. These brackets will be the first ever introduced Airbus systems parts to be qualified for printed titanium.



<https://www.aero-mag.com/liebherr-aerospace-airbus-3d-printing-a350-xwb/>

11/09/2019

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### Hexcel additive manufacturing process approved by Boeing

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Hexcel Corporation has been approved by Boeing to produce HexPEKK-100 aerospace structures for major commercial aircraft platforms. After rigorous review of Hexcel's proprietary poly-etherketone-ketone and carbon fibre material formulation, Hexcel's HexPEKK-100 end-use components – as well as its HexAM additive manufacturing process which uses selective laser sintering – are now obtainable through Boeing's qualified provider list. These HexPEKK components will be manufactured-to-print for commercial aerospace applications where complexity, weight reduction, and strong mechanical performance are critical.



<https://www.aero-mag.com/hexcel-additive-manufacturing-process-approved-by-boeing/>

## PUBLICACIONES CIENTÍFICAS

### AUTOMOCIÓN

Julio/2019

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### Environmental assessment of additive manufacturing in the automotive industry

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*Daniel Böckin, Anne-Marie Tillman*

3D-printing, also known as Additive Manufacturing (AM), is an emerging technology with suggested potential to decrease environmental impacts in the manufacturing industry. Potential benefits from implementing the technology include reduced product weight, transportation and material losses, as well as improved functionality and possibility for printing of spare parts. Possible drawbacks are increased energy use in production and the slow printing process. As the technology is expected to grow significantly, it is important to assess potential environmental effects of implementation. In this study a Life Cycle Assessment (LCA) is used in the case of Powder Bed Fusion (PBF) of the metal parts of an engine in a light distribution truck.

<https://www.sciencedirect.com/science/article/pii/S0959652619311631>

Agosto/2019

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### Additive manufacturing: empirical evidence for supply chain integration and performance from the automotive industry

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*Mia Delic, Daniel R. Evers, Josip Mikulic*

Additive Manufacturing offers much potential for industry, but at the same time is likely to have a significant impact on supply chain theory and practice. To-date there has been limited empirical work exploring the effect of Additive Manufacturing, and this study aims to provide a detailed appraisal of how supply chain integration, supply chain performance and firm performance may be affected by the adoption of Additive Manufacturing. These are critical factors for supply chain management but have received little quantified attention to date.

<https://www.emerald.com/insight/content/doi/10.1108/SCM-12-2017-0406/full/html>



## AERONÁUTICA

Febrero/2019

### **Additive Manufacturing for the Aircraft Industry: A Review**

*Sarat Singamneni, Yifan Lv, Andrew Hewitt, Rodger Chalk*

Considering the stringent regulations, manufacturing of aircraft parts is often quite complex and time consuming. The multi-million components, multi-tier manufacturing systems and the severe constraints surrounding the sector lead to heavy inventory investments to achieve the just-in-time supply of parts often needed to reduce the airplane ground times. Additive manufacturing evolved allowing for the direct production of complex parts based on digital data with no complex tooling or machinery, a messiah of true just in time production. Appropriate integration of additive manufacturing with the aircraft industry could resolve some of the supply chain and inventory hurdles. Significant progress is already evident in these lines, but the lack of quality assurance attributes and certification standards is hampering the progress.

[https://www.researchgate.net/publication/331482685 Additive Manufacturing for the Aircraft Industry A Review](https://www.researchgate.net/publication/331482685_Additive_Manufacturing_for_the_Aircraft_Industry_A_Review)

Marzo/2019

### **Additive manufacturing by wire based laser metal deposition**

*M. Valentin, C. Arnaud, R. Kling*

Laser additive manufacturing with metals is gaining more and more attention, and represents a large market in industrial applications, specifically for the aerospace sector in the future. The increasing diversity of applications requires the continuous development of specific process implementations: For high metal deposition rates, developments have focused on arc technologies (Wire Arc Additive Manufacturing, WAAM), based on conventional welding techniques. For high definition 3D parts, the development of laser technologies allowed the implementation of layer-based metal solidification on powder beds known as Selective Laser Melting (SLM). In this paper, we will present the interest of wire-based deposition technologies with lasers, often referred to as laser metals deposition by wire (LMD-W).

<https://www.spiedigitallibrary.org/conference-proceedings-of-spie/10909/109090L/Additive-manufacturing-by-wire-based-laser-metal-deposition/10.1117/12.2510074.short?SSO=1>

Noviembre/2019

### **Review: The Impact of Metal Additive Manufacturing on the Aerospace Industry**

*Shahir Mohd Yusuf, Samuel Cutler, Nong Gao*

Metal additive manufacturing (AM) has matured from its infancy in the research stage to the fabrication of a wide range of commercial functional applications. In particular, at present, metal AM is now popular in the aerospace industry to build and repair various components for commercial and military aircraft, as well as outer space vehicles. Firstly, this review describes the categories of AM technologies that are commonly used to fabricate metallic



parts. Then, the evolution of metal AM used in the aerospace industry from just prototyping to the manufacturing of propulsion systems and structural components is also highlighted.

<https://www.mdpi.com/2075-4701/9/12/1286/htm>

## SECCIÓN III. FABRICACIÓN DIGITAL

### NOTICIAS

#### AUTOMOCIÓN

18/03/2019

#### El Centro de Groupe PSA en Vigo desarrolla el 'Big Data Pintura'

La Oficina Técnica de Mantenimiento del Departamento de Pintura del Centro de Groupe PSA en Vigo ha desarrollado un proyecto pionero basado en el análisis y tratamiento de datos para mejorar los procesos de pintura de los vehículos. Un software se encargará de recoger todos los datos de los autómatas de proceso relacionados con el vehículo (temperatura de la cabina, atmósfera, humedad, parámetros de las pinturas, tiempos de cocción...), que se cruzan con los resultados de calidad de cada carrocería pintada.



<http://www.auto-revista.com/texto-diario/mostrar/1545674/centro-groupe-psa-vigo-desarrolla-big-data-pintura>

04/04/2019

#### Volkswagen colabora con Siemens en el desarrollo del Industrial Cloud

El grupo tecnológico Siemens se convertirá en socio de integración de Volkswagen Industrial Cloud para garantizar que la maquinaria y los equipos de distintos proveedores en las 122 plantas de Volkswagen estén interconectados de forma eficiente a través de la nube. La transparencia y el análisis de datos resultantes sentará las bases tecnológicas de mejoras adicionales de la productividad en las plantas de Volkswagen. Además, Siemens y los proveedores de maquinaria y equipos crearán aplicaciones a partir del sistema de Internet de las Cosas MindSphere, disponible en Volkswagen Industrial Cloud.



<http://www.automataeinstrumentacion.com/es/notices/2019/04/siemens-colabora-con-volkswagen-para-desarrollar-su-industrial-cloud-45371.php>

09/10/2019

#### El proyecto de mantenimiento predictivo de Ford Valencia gana el Henry Ford Technology Award



El proyecto "Miniterms 4.0" realizado por Ford Valencia y la Universidad CEU Cardenal Herrera (CEU-UCH) ha sido premiado con Henry Ford Technology Award, que reconoce la mejor innovación del año en Ford en sus 80 plantas. El proyecto ganador 'IIoT - Real-Time Predictive Maintenance Support System - Miniterms 4.0' se trata de un modelo de predicción de averías en las líneas de producción de carrocerías y prensas.



<https://www.infopl.net/actualidad-industrial/item/107001-proyecto-mantenimiento-predictivo-ford-valencia-gana-henry-ford-technology-award>

## AERONÁUTICA

07/02/2019

### Airbus and Dassault Systèmes agree partnership on future technology

Airbus and Dassault Systèmes have signed a five-year memorandum of agreement (MOA) to implement collaborative 3D design, engineering, manufacturing, simulation and intelligence applications. This will enable Airbus to take a major step forward in its digital transformation and lay the foundation for a new European industrial ecosystem in aviation. Under the MOA, Airbus will deploy Dassault Systèmes' 3DEXPERIENCE platform, which delivers digital continuity, from design to operations, in a single data model for a unified user experience.



<https://www.aero-mag.com/airbus-and-dassault-systemes-agree-partnership-on-future-technology/>

24/10/2019

### Lockheed Martin selects Dassault Systèmes' 3DEXPERIENCE platform

Dassault Systèmes has announced that Lockheed Martin is deploying the 3DEXPERIENCE platform to support its digital engineering initiatives. Through this multi-year collaboration between the two companies, Lockheed Martin aims to build a digital thread that extends from design through manufacturing for its next generation airplanes and helicopters. Lockheed Martin is using a variety of industry solution experiences based on the 3DEXPERIENCE platform as part of a larger suite of digital engineering tools.



<https://www.aero-mag.com/lockheed-martin-selects-dassault-systemes-3dexperience-platform/>

## PUBLICACIONES CIENTÍFICAS

### AUTOMOCIÓN

Marzo/2019

### Digital twin for adaptation of robots' behaviour in flexible robotic assembly lines



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*Niki Kousi, Christos Gkournelos, Sotiris Aivaliotis, Christos Giannoulis, George Michalos, Sotiris Makris*

This paper investigates the use of digital world modelling techniques in such hybrid production systems for enabling system reconfiguration through shared environment and process perception. The suggested digital world model infrastructure involves three main functionalities: a) Virtual representation of the shopfloor, combining multiple sensor data and CAD models. The digital shopfloor is rendered in the 3D environment exploiting the capabilities provided by Robot Operating System (ROS) framework, b) Semantic representation of the world through the implementation of a unified data model for representing the geometrical as well as the workload state, and c) Dynamic update of the digital twin based on real time sensor and resource data coming from the actual shopfloor.

<https://www.sciencedirect.com/science/article/pii/S2351978918313623>

Mayo/2019

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### **Development and operation of Digital Twins for technical systems and services**

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*Rainer Stark, Carina Fresemann, Kai Lindow*

Digital Twins are new solution elements to enable ongoing digital monitoring and active functional improvement of interconnected products, devices and machines. In addition, benefits of horizontal and vertical integration in manufacturing are targeted by the introduction of Digital Twins. Using the test environment of smart factory cells, this paper investigates methodological, technological, operative, and business aspects of developing and operating Digital Twins. The following Digital Twin dimensions are considered in scientific and application oriented analysis: (1) integration breadth, (2) connectivity modes, (3) update frequency, (4) CPS intelligence, (5) simulation capabilities, (6) digital model richness, (7) human interaction, and (8) product lifecycle.

<https://www.sciencedirect.com/science/article/abs/pii/S0007850619300502>

Septiembre/2019

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### **Potential applications of 5G communication technologies in collaborative intelligent manufacturing**

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*Yanjun Shi, Qiaomei Han, Weiming Shen, Hui Zhang*

Nowadays most of the communication technologies used in the manufacturing industry are still wired, including various fieldbuses and dedicated industrial Ethernet technologies, though wireless communication technologies including WiFi and ZigBee are recently being adopted. This study is to investigate the integration of 5G wireless communication technologies with collaborative intelligent manufacturing (CIM) processes and systems. 5G technologies and typical scenarios including enhanced mobile broadband, massive machine type communications, and ultra-reliable low latency communication are introduced. Various possible applications or business slices of 5G in CIM are analysed, including human-machine interfaces and production IT, process automation, factory automation, logistics and warehousing, monitoring, and maintenance.

<https://digital-library.theiet.org/content/journals/10.1049/iet-cim.2019.0007>



## AERONÁUTICA

Marzo/2019

### **Analysis of the opportunities of industry 4.0 in the aeronautical sector**

*Ines Guyon, Rachid Amine, Simon Tamayo, Frédéric Fontane*

This article presents an overview of the challenges of Industry 4.0 alongside those of the aeronautical sector, proposing a critical analysis of the opportunities offered by the former to the latter. Our work discusses the Fourth Industrial Revolution, a disruption based on the most important innovation of recent years, which will have a huge impact on the world we know today.

<https://hal.archives-ouvertes.fr/hal-02063948/document>

Octubre/2019

### **Application framework of digital twin-driven product smart manufacturing system: A case study of aeroengine blade manufacturing**

*Xuqian Zhang, Wenhua Zhu*

In the wake of the continuous deepening of the application of new generation information technology in the manufacturing field, digital twin, as a most new active factors for smart manufacturing, has become a new research hot spot. Based on such a background, the article proposes a novel application framework of digital twin-driven product smart manufacturing system and analyzes its operation mechanism. Key enabling technologies such as digital twin mapping technology with manufacturing entity, twinning of cyber and physical manufacturing system, as well as twinning data-driven machining parameter optimization are also illustrated in detail. Finally, a case of the aeroengine fan blade manufacturing is given to demonstrate the feasibility and effectiveness of the implementation method mentioned above. Meanwhile, potential industrial applications and limitations are discussed as well to provide valuable insights to aeroengine blade manufacturers.

<https://journals.sagepub.com/doi/full/10.1177/1729881419880663>



## SECCIÓN IV. LOGÍSTICA AVANZADA

### NOTICIAS

#### AUTOMOCIÓN

21/02/2019

#### IBM revoluciona el seguimiento de contenedores con Sigfox dentro del Grupo PSA

IBM anuncia junto a Sigfox el lanzamiento –dentro del Grupo PSA– de la innovadora solución “Track & Trace” para la digitalización del seguimiento de envases (contenedores) entre proveedores y plantas de ensamblaje. Esta solución, basada en la solución de Internet de las cosas de IBM y la red internacional “OG” de Sigfox, permite al Grupo PSA optimizar la rotación de contenedores entre los diferentes sitios de sus proveedores y sus fábricas (bucles). Con “Track & Trace” y gracias a la solución Watson IoT, el Grupo PSA supervisa en tiempo real a través de la red Sigfox sus contenedores equipados con sensores.

<https://www.sigfox.es/blogs/post/IBM-PSA-SIGFOX>



09/10/2019

#### Ford Spain uses MiR collaborative mobile robots to increase productivity

For decades, Ford Motor Co. has used robots to make automobiles. When its factory in Almussafes-Valencia, Spain, needed to automate a tedious process, Ford Spain recently deployed collaborative mobile robots from Mobile Industrial Robots ApS. Ford Spain bought its first MiR100 robot a year and a half ago. The autonomous mobile robot (AMR) is named for its payload capacity of 100kg (220.4 lb.) and delivers spare parts in the plant. It is able to avoid unforeseen obstacles, modify its route as necessary, and work alongside humans and other vehicles.

<https://www.cobottrends.com/ford-spain-uses-mir-collaborative-mobile-robots-increase-productivity/>



12/11/2019

#### Seat drone delivery project takes flight

Following trials earlier this year Spanish carmaker Seat is now using drones to routinely deliver steering wheels and airbags at its Martorell factory near Barcelona. Once an order is received by compatriot logistics company Grupo Sesé, Seat’s partner in the current test phase, the component is loaded into a carbon fibre capsule weighing 5.5 kg and firmly attached to the drone with an electromagnet and is ready for airborne delivery from the launch pad, the OEM said. Measuring 1.7 metres across, the drone takes off for the two-kilometre flight from the logistics centre to assembly workshop.



<https://www.automotivelogistics.media/seat-drone-delivery-project-takes-flight/39598.article>

## AERONÁUTICA

03/01/2019

### Autonomous robots to transport huge aircraft wings for Airbus

The ambitious project, in collaboration with engineers at the AMRC's Integrated Manufacturing Group, began by developing safe, automated means of delivering tooling supplies internally within the Airbus factory at Broughton in Wales, but could be expanded rapidly as the benefits of using small, autonomous robotic vehicles are being realised on the shop floor. The project was initiated to fulfil Airbus' vision of automating component handling which involves significant amount of manual work due to the sheer size of the components and precision required during aircraft assembly.



<http://www.connectivity4ir.co.uk/article/163749/Autonomous-robots-to-transport-huge-aircraft-wings-for-Airbus.aspx>

## PUBLICACIONES CIENTÍFICAS

### AUTOMOCIÓN

Abril/2019

### Evaluation of Navigation in Mobile Robots for Long-Term Autonomy in Automotive Manufacturing Environments

*Jaspri Singh Gill, Mark Tomaszewski, Yunyi Jia, Pierluigi Pisu, Venkat N Krovi*

In recent times, a number of reference implementations of Simultaneous Localization and Mapping (SLAM) and navigation techniques have been made publicly available via the ROS Community. Several implementations have transitioned to commercial products (vacuum robots, drones, warehouse robots, etc.). However, in such cases, they are specialized and optimized for their specific domains of deployment. In particular, their success criteria have been based primarily on mission completion and safety of humans around them. In this light, deployment in any new operational design domain (ODD) requires at least a careful verification of performance and often re-optimization.

<https://www.sae.org/publications/technical-papers/content/2019-01-0505/>

Septiembre/2019

### Drones in manufacturing: exploring opportunities for research and practice

*Omid Maghazei, Torbjørn Netland*

The purpose of this paper is to explore current and potential applications of drones in manufacturing, examine the opportunities and challenges involved and propose a research agenda. The paper reports the result of an extensive qualitative investigation into an emerging phenomenon. The authors build on the literature on advanced manufacturing technologies. Data collected through in-depth interviews with 66 drone experts from 56 drone vendors and related services are analyzed using an inductive research design. Drones



represent a promising AMT that is expected to be used in several applications in manufacturing in the next few years.

<https://www.emerald.com/insight/content/doi/10.1108/JMTM-03-2019-0099/full/html>

Noviembre/2019

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### **State-of-the-Art Review of Autonomous Intelligent Vehicles (AIV) Technologies for the Automotive and Manufacturing Industry**

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*Con Cronin, Andrew Conway, Joseph Walsh*

Research in Autonomous Intelligent Vehicles (AIV) has been done for the past 25 years and is continuously creating advancements and capabilities. AIVs will out-strip Automated Guided Vehicles (AGV) as leaders of material handling equipment. It is the ability of AIVs to operate remotely and safely with repeatability at the request and demand of the Manufacturing Execution System (MES). Integration of AIV technologies will increase productivity through consistent and seamless transportation of product in current manufacturing environments. AIV technology removes the mundane laborious manual operations from the human operator, offering workers the ability to work in a more meaningful role within the production line. Increased manufacturing output will ultimately benefit the economy and job security. This review paper will examine AIV technologies for advanced flexible manufacturing systems to improve manufacturing processes. The removal of conveyors and the inclusion of AIVs will promote flexibility within the factory floor and increase the realisation of Industry 4.0

<https://ieeexplore.ieee.org/abstract/document/8904920>

### **AERONÁUTICA**

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Junio/2019

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### **Drone Stations in Airports for Runway and Airplane Inspection Using Image Processing Techniques**

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*Rebecca N. Sappington, Gabriel A. Acosta, Mostafa Hassanalain, Kooktae Lee, Ryan Morelli*

Drones have many applications in airports including inspection of the runway, airplanes health monitoring, for mitigation, and bird strike avoidance. To this end, the integration of unmanned aerial systems into airports can be beneficial, which will be discussed in this paper. For example, monitoring the runways at an airport using drones can be a feasible operation. In this paper, a drone is used to monitor an Airport runway to find cracks and potholes that need repairing. This is done using an image processing technique to single out areas of interest. In this paper, a station to dock and recharge the drones is also proposed. The nesting location, design, and safety concerns for using the drones and docking stations are discussed.

<https://arc.aiaa.org/doi/abs/10.2514/6.2019-3316>



## SECCIÓN V. OPERARIO SENSORIZADO

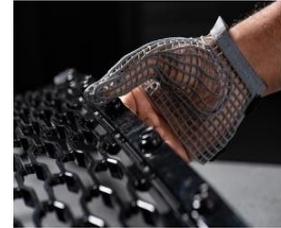
### NOTICIAS

#### AUTOMOCIÓN

26/09/2019

#### 3D-printed glove to aid assembly workers

UK - Jaguar Land Rover has recently carried out trials of a 3D-printed glove and is now working on a second-generation prototype. The glove, which was designed in-house at the company's facility in Gaydon, has been used as a piece of protective clothing to safeguard production line workers from the threat of a musculoskeletal disorder. The glove has been used, for example, by workers that fit clips and fasteners to the chassis during assembly. The second-generation glove will include a foam pad made using impact additive D30 - a polymer material that absorbs impact when placed under pressure.



<https://www.automotivemanufacturingsolutions.com/additive/3d-printing/3d-printed-glove-to-aid-assembly-workers/39218.article>

31/10/2019

#### Nissan puts exoskeleton to the test

At its production trial facility in Spain, Nissan has tested exoskeleton devices designed to offer better support to the legs, shoulders, and backs of assembly workers. The next phase of the project is going to begin early next year and will integrate use of the devices into a production process setting at the Zona Franca plant near Barcelona. Examining feedback from 14 participating employees, Nissan has identified two models that offered the optimum combination of lowest weight and best performance. The devices are made of light alloy materials and weigh between 1.5kg and 3kg.



<https://www.automotivemanufacturingsolutions.com/assembly/nissan-puts-exoskeletons-to-the-test/39525.article>

11/12/2019

#### Exoskeleton trials underway at Audi

A comparative study comprising around 60 employees from Audi's assembly, paintshop and toolmaking is running two devices – the Paexo from Ottobock and the Skelex 360 from Skelex – to assess performance in difficult overhead jobs...The tasks being tested at Ingolstadt are for both static and dynamic activities, for example, brake line installation, attaching the underbody paneling and applying corrosion and sealing protection. The devices are worn by the employee on the shoulders and secured in place with a belt around the hips, similar to a backpack.



<https://www.automotivemanufacturingsolutions.com/oems/exoskeleton-trials-underway-at-audi/39749.article>

## PUBLICACIONES CIENTÍFICAS

### AUTOMOCIÓN

Marzo/2019

#### **A Field Evaluation of Arm-Support Exoskeleton for Overhead Work Applications in Automotive Assembly**

*Marty Smets*

The results of this field trial suggest that when made available for optional usage during overhead automotive assembly, arm-support exoskeletons can lead to a substantial decrease in self-reported musculoskeletal discomfort in the neck and shoulders. Participants (assembly operators) chose to use the device for 86% of their shift and indicated they would continue to use it daily if provided the opportunity. The results of this investigation suggest that when used alongside a traditional proactive ergonomics program, arm-support exoskeletons may reduce some risk factors associated with the development of shoulder injuries. The approach presented may be useful for practitioners that are starting to explore arm-support exoskeletons in their workplace.

<https://www.tandfonline.com/doi/full/10.1080/24725838.2018.1563010>

Abril/2019

#### **Human-centred approach in Industry 4.0**

*Petr Marcon, Jakub Arm, Tomas Benesl, Frantisek Zezulka, Christian Diedrich, Tizian Schröder, Alexander Belyaev, Premysl Dohnal, Tomas Kriz, Zdenek Bradac*

The paper discusses the possibilities of incorporating sensors and indicators into the environment of an Industry 4.0 digital factory. The concept of Industry 4.0 (I4.0) is characterized via a brief description of the RAMI 4.0 and I4.0 component model. In this context, the article outlines the structure of an I4.0 production component, interpreting such an item as a body integrating the asset and its electronic form, namely, the Asset Administration Shell (AAS). The formation of the AAS sub-models from the perspectives of identification, communication, configuration, safety, and condition monitoring is also described to complete the main analysis. Importantly, the authors utilize concrete use cases to demonstrate the roles of the given I4.0 component model and relevant SW technologies in creating the AAS.

<https://www.mdpi.com/1424-8220/19/7/1592>

Abril/2019

#### **Subjective Evaluation of a Passive Industrial Exoskeleton for Lower-back Support: A Field Study in the Automotive Sector**

*Ralph Hensel, Mathias Keil*

A passive, low-back support exoskeleton (Laevo) was tested in a four-week field study with workers in several automobile manufacturing workplaces that included both static trunk postures (forward bending) and dynamic repositioning (manual material handling). The aims of the study were to obtain subjective evaluations of the impacts of exoskeleton use, including



discomfort, usability, and user acceptance. Workers overall reported a decrease in physical discomfort in the lower back when using the passive exoskeleton, although this decrease was only evident in work requiring static vs. dynamic postures.

<https://www.tandfonline.com/doi/full/10.1080/24725838.2019.1573770>

Mayo/2019

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### **Industrial Exoskeleton Technology: Classification, Structural Analysis, and Structural Complexity Indicator**

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*A. Voilqué, J. Masood, J.C. Fauroux, L. Sabourin, O. Guezet*

In recent years, exoskeleton technology has become of interest to the industrial manufacturing sector. It offers a new approach to improving the quality of work, task effectiveness and productivity by combining human intelligence and dexterity with robotic or mechanical assistance. In this paper, we classify the industrial needs into three categories: awkward posture and movements, heavy workload manipulation, and assembly effort assistance. Examples from car manufacturing are used to illustrate the presented classification. Our literature review reveals 62 exoskeleton solutions with industrial potentials. We list them according to continent source, development status, mass, targeted body part support, actuation type, energy source, and the proposed industrial needs. By analysing existing devices, we highlight prominent issues related to their structure and actuation technology.

<https://ieeexplore.ieee.org/document/8719395>

Octubre/2019

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### **The Amount of Support Provided by a Passive Arm Support Exoskeleton in a Range of Elevated Arm Postures**

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*Aijse de Vries, Molly Murphy, Reinier Könemann, Idsart Kingma, Michiel de Looze*

Our study quantified the extent of support provided by a passive arm-support exoskeleton throughout a range of postures. Mechanical support generated by the arm-support exoskeleton (SkelEx, Rotterdam, The Netherlands) that we tested clearly reaches its maximum at elevation angles ranging from 60° to 120°, where the required support is also highest. In contrast, for elevation angles below 30°, this exoskeleton provided significantly less support. Depending on the task, other support characteristics might be required. These results may help practitioners who are considering the adoption of an exoskeleton in the workplace. We advocate adapting mechanical support settings or effective range to the actual specific working envelope of postures.

<https://www.tandfonline.com/doi/full/10.1080/24725838.2019.1669736>



## SECCIÓN VI. ROBÓTICA COLABORATIVA

### NOTICIAS

#### AUTOMOCIÓN

12/08/2019

##### El robot colaborativo que da nombre a los coches de SEAT

La planta de SEAT en Martorell ha implementado con éxito dos singulares robots colaborativos. Trabajan en la parte inicial de la cadena de montaje y son los encargados de poner en el portón de los coches los nombres de los SEAT Ibiza y Arona a su paso por la línea, sin detener el proceso y compartiendo espacio con los operarios. Ambos robots, ubicados a ambos lados de la línea, están dotados de una mano diseñada para coger los diferentes tipos de letras mediante succión por ventosas, retirar el papel trasero protector, adherirlas al coche aplicando la fuerza exigida, quitar el protector delantero y tirarlo a un contenedor para su reciclaje.



<https://www.izaro.com/el-robot-colaborativo-que-da-nombre-a-los-coches-de-seat/c-1566571163/>

13/09/2019

##### Audi tests new sealing process in paint shop

Audi has started testing a new sealing process in the paint shop at its plant in Győr, Hungary. The OEM has stated that it will result in cutting carbon emissions while simultaneously having a positive impact on employees. The new process is called digital sealing and has been developed in partnership with Atlas Copco - a Swedish company specializing in making tools and equipment for industrial applications. It works by using a robot-guided applicator to deposit droplets of paste-like sealing material in uniform quality to the car body with high accuracy. Operators are able to program the optimal width and thickness of material to be applied, resulting in less waste and reducing vehicle weight by several kilograms.



<https://www.automotivemanufacturingsolutions.com/paintshop/audi-tests-new-sealing-process-in-paint-shop/39085.article>

01/10/2019

##### Zippertubing uses UR5 cobot to guarantee product quality

The Zippertubing Company makes shielding for electromagnetic interference, as well as specialized heat shrink, cable bundling, heat shielding, and marine fairing products. It needed to increase quality and throughput amid a shortage of skilled workers. Zippertubing has chosen a UR5 collaborative robot arm from Universal Robots A/S to tend its snap-set cable wrapping machines. The robot simply looks for feedback from the camera. If it doesn't find it, it says it's a



bad part. If it finds it, that means that the part was good, and it sorts it accordingly.

<https://www.cobottrends.com/zipertubing-uses-ur5-cobot-to-guarantee-product-quality/>  
04/10/2019

### **Ford implanta una coreografía para robots en la línea de montaje del Fiesta**

Ford ha implantado por primera vez un equipo de robots colaborativos (cobots) que trabajan junto a ingenieros en Colonia (Alemania) para asegurar que cada Ford Fiesta tenga un acabado perfecto. Los seis cobots completan una secuencia coreografiada para lijar toda la superficie del chasis en solo 35 segundos. La iniciativa no sustituye a los empleados, sino que permite a los operadores utilizar su tiempo en tareas más complejas y evitar que sufran el estrés asociado a la realización de tareas repetitivas.



<http://www.auto-revista.com/texto-diario/mostrar/1822174/ford-implanta-coreografia-robots-linea-montaje-fiesta>

### **AERONÁUTICA**

01/10/2019

### **Airbus inaugurate Hamburg A320 structure assembly line**

Airbus has inaugurated its highly automated fuselage structure assembly line for A320 Family aircraft in Hamburg, showcasing an evolution in Airbus' industrial production system. With a special focus on manufacturing longer sections for the A321LR, the new facility features 20 robots, a new logistics concept, automated positioning by laser measurement as well as a digital data acquisition system. These will further support Airbus' drive to improve both quality and efficiency while bringing an enhanced level of digitalisation to its industrial production system.



<https://www.aero-mag.com/airbus-inaugurate-hamburg-a320-structure-assembly-line/>

## **PUBLICACIONES CIENTÍFICAS**

### **AUTOMOCIÓN**

Febrero/2019

### **A Brief Overview of the Use of Collaborative Robots in Industry 4.0: Human Role and Safety**

*Sara Bragança, Eris Costa, Ignacio Castellucci, Pedro M. Arezes*

Industry 4.0 is a new industrial paradigm that brings new challenges for workers as they have to actively collaborate with robots in an interconnected environment. The main purpose of this paper is to give a brief overview of how collaborative robots can be used to support human workers in Industry 4.0 manufacturing environments. The use of collaborative robots certainly brings many advantages as these machines enable more efficient product systems by supporting workers with both physical and cognitive tasks, as is the case of exoskeletons.



On the other hand, human–robot interaction might also have some risks if human factors considerations are not well thought through throughout the process. Moreover, it becomes clear that the role that humans have been playing so far in a manufacturing environment is rapidly changing.

[https://link.springer.com/chapter/10.1007/978-3-030-14730-3\\_68](https://link.springer.com/chapter/10.1007/978-3-030-14730-3_68)

Abril/2019

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### **Drivers Impacting Cobots Adoption in Manufacturing Context: A Qualitative Study**

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*Ana C. Simões, António Lucas Soares, Ana C. Barros*

Today's manufacturing environment is increasingly pressured to higher flexibility induced by uncertain production volumes as well as uncertain product lifetime. A way to improve productivity in a flexible production system is by using a safe and flexible cooperation between robot and operator. Therefore, manufacturing companies are experiencing an increase in human-robot interactions and in the use of collaborative robots (cobots). By means of in-depth interviews in six companies in Portugal and France, this study provides a comprehensive understanding of the drivers that influence the intent to adopt, or the effective adoption, of cobots and the alignment of these drivers with the strategic objectives of the company.

[https://link.springer.com/chapter/10.1007/978-3-030-18715-6\\_17](https://link.springer.com/chapter/10.1007/978-3-030-18715-6_17)

Agosto/2019

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### **Balancing of assembly lines with collaborative robots**

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*Christian Weckenborg, Karsten Kieckhäfer, Christoph Müller, Martin Grunewald & Thomas S. Spengler*

Motivated by recent developments to deploy collaborative robots in industrial production systems, we investigate the assembly line balancing problem with collaborative robots. The problem is characterized by the possibility that human and robots can simultaneously execute tasks at the same workpiece either in parallel or in collaboration. For this novel problem type, we present a mixed-integer programming formulation for balancing and scheduling of assembly lines with collaborative robots. The model decides on both the assignment of collaborative robots to stations and the distribution of workload to workers and robotic partners, aiming to minimize the cycle time. Given the high problem complexity, a hybrid genetic algorithm is presented as a solution procedure.

<https://link.springer.com/article/10.1007/s40685-019-0101-y>

## **AERONÁUTICA**

Octubre/2019

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### **Humanoid Robots in Aircraft Manufacturing: The Airbus Use Cases**

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*Abderrahmane Kheddar, Stephane Caron, Pierre Gergondet, Andrew Comport, Arnaud Tanguy, Christian Ott, Bernd Henze et al.*

We report on the results of a collaborative project that investigated the deployment of humanoid robotic solutions in air-craft manufacturing for several assembly operations where access by wheeled or railported robotic platforms is not possible. Recent developments in



multicontact planning and control, bipedal walking, embedded simultaneous localization and mapping (SLAM), whole-body multisensory task-space optimization control, and contact detection and safety suggest that humanoids could be a plausible solution for automation, given the specific requirements in large-scale manufacturing sites.

<https://ieeexplore.ieee.org/document/8889461>

Noviembre/2019

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### **The concept of an aircraft hull structures assembly process robotization**

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*V. Serebrenny, D. Lapin, A. Mokaeva*

This article presents the concept of an aircraft hull structures assembly process robotization, primary analysis and detailing were carried out. The essence of this solution is in the cooperation between worker and collaborative robot within the framework of one technological process – drilling and riveting. The collaborative robot performs the most of monotonous operations, the worker is involved when performing operations in a work area inaccessible to the robot. Such a combination makes it possible to reduce the total operational time and overall labor intensity with minimal interference with the existing process. The proposed concept of assembly robotization allows bringing a significant part of human labor out of the technological chain. The key element to achieve this advantage is the development of collaborative robotic tools based on existing technological rigging, taking into account their adaptation to the capabilities of modern collaborative robots, as well as the achievement of a high level of ergonomics and safety. Wherein, the basic technical solutions of the concept have a relatively low total cost.

<https://aip.scitation.org/doi/abs/10.1063/1.5133318>

