



1<sup>ST</sup> INTERNATIONAL CONGRESS  
ON  
ADDITIVE MANUFACTURING  
BOOK OF ABSTRACTS

IWAM 22



SEPTEMBER 30, 2022



**1<sup>ST</sup> INTERNATIONAL CONGRESS**

**ON**

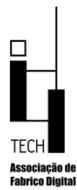
**ADDITIVE MANUFACTURING**

**BOOK OF ABSTRACTS**

**IWAM 22**

Bragança - Portugal

September 2022



**factoryplay**

**FIDELIDADE**  
SEGUROS DESDE 1808



União das Freguesias de  
Sé, Santa Maria e Meixedo



Caixa CA  
**FUNDAÇÃO**

## EDITORS

João Rocha, Instituto Politécnico de Bragança, Portugal

João Eduardo Ribeiro, Instituto Politécnico de Bragança, Portugal

Jorge Santos, Instituto Politécnico de Bragança, Portugal

Rui A. Lima, Universidade do Minho, Portugal

Instituto Politécnico de Bragança 2022

Campus de Santa Apolónia

5300-253 Bragança - Portugal

ISBN: 978-972-745-310-8

<http://hdl.handle.net/10198/23947>

Book cover: Jorge Santos, Instituto Politécnico de Bragança

Technical Support: Clarisse Pais, Instituto Politécnico de Bragança

# WELCOME

Additive manufacturing technologies are playing a decisive role in the laboratory environment, making a significant difference in STEAM education. Students use additive manufacturing to create physical models, topographic maps, biology artifacts, artwork, all types of engineering prototypes and solving mathematics challenges. By bringing additive manufacturing capabilities to the classroom, educators can raise interest in STEAM, introduce new concepts and capabilities, and help set the future for more skilled STEAM professionals.

The IWAM 2022 Organizing Committee,

João Rocha

João E. Ribeiro

Jorge Santos

Rui Lima

## **COMMITTEES**

### **ORGANIZING COMMITTEE**

João Rocha, Instituto Politécnico de Bragança, Portugal

João Eduardo Ribeiro, Instituto Politécnico de Bragança, Portugal

Jorge Santos, Instituto Politécnico de Bragança, Portugal

Rui A. Lima, Universidade do Minho, Portugal

### **INTERNATIONAL SCIENTIFIC COMMITTEE**

João Eduardo Ribeiro, Instituto Politécnico de Bragança, Portugal

João Rocha, Instituto Politécnico de Bragança, Portugal

Isabel Lopes, Instituto Politécnico de Bragança, Portugal

Rui A. Lima, Universidade do Minho, Portugal

Diana Pinho, International Iberian Nanotechnology Laboratory, Portugal

Viviane Teleginski, Universidade Tecnológica Federal do Paraná, Brazil

Ana Moita, Academia Militar / IN+(IST), Portugal

Helder Puga, Universidade do Minho, Portugal

Eleonora Santecchia, Università Politecnica delle Marche, Italy

Borja F. Villar, Centro tecnológico CARTIF, Spain

Alvaro Prieto, Centro tecnológico CARTIF, Spain

Jolanta Pileckiene, Vilnius College of Technologies and Design, VTDK, Lithuania

Teresa Guarda, Faculty of Systems and Telecommunications, UPSE, Ecuador

Paula Vaz, Instituto Politécnico de Bragança, Portugal

Lidia Sánchez González, University of Leon, Spain

Manuel Rodríguez Martín, University of Salamanca, Spain

Romeu Rony Cavalcante da Costa, Federal Technological University of Paraná, Brazil

Renato Goulart Jasinevicius, Escola de Engenharia de São Carlos - USP, Brazil

Fátima Vaz, IST, Universidade de Lisboa, Portugal

Delfim Soares, Universidade do Minho, Portugal

José Gonçalves, Instituto Politécnico de Bragança, Portugal

Flora Silva, Instituto Politécnico de Bragança, Portugal

Paula M. Barros, Instituto Politécnico de Bragança, Portugal



TABLE OF CONTENTS

*Capillarity assessment of 18Ni300 maraging steel cellular structures manufactured by Selective Laser Melting..... 9*

*Influence on heat transfer of the interface contact configuration between two dissimilar steels ..... 13*

*Cooling performance of an acrylic serpentine with a rectangular cross section..... 16*

*Development of a modular thermal management system for CBRN equipment by additive manufacturing using stereolithography..... 19*

*Development of a low cost personal protective mask by stereolithography..... 22*

*Submerged energy harvesting device fabricated by a desktop 3D printer..... 25*

*Evaluation of mechanical properties of lattice structures for sandwich panels ..... 28*

*A simple method to modify the wettability of the PDMS surface for biomedical applications ..... 29*

*Control of the dimensional variation adjusting the thermal drying cycle of abrasive composites with incorporated PLA ..... 35*

*Additive manufacturing techniques for the fabrication of intracranial aneurysm biomodels..... 39*

*From kindergarten to fablab - teaching Maker movement and digital fabrication.... 42*

*Promote learning through knowledge sharing between higher education courses with interconnection to the business context..... 46*

*The Importance of Smart Cities and Urban Policies for the Interior of the Country 48*

*The importance of STEAM education in schools: literature review..... 51*

*The power of Additive Manufacturing as a STEAM educational tool..... 54*

*Application of the STEAM methodology for laser scanning of historic buildings..... 56*

*Manufacture wing models to analyze air fluid flow in wind tunnel using a 3D printer ..... 58*

*Mechanical characterization of specimens manufactured in 3D printing..... 61*

*Manufacture and development of a 3D printing handle for laparoscopic application ..... 64*

*Tensile and flexural strength of flax fiber reinforced composites with and without chemical treatment..... 67*

*Electronic solution with joysticks for laparoscopic equipment..... 69*

*Construction of an optimized 3D Printer, programmed by Arduino and designed in SolidWorks software ..... 72*

## **Application of the STEAM methodology for laser scanning of historic buildings**

H.C.L. Carvalho<sup>1,\*</sup>, Jorge Santos<sup>1</sup>, I. Lopes<sup>1</sup>, J.E. Ribeiro<sup>1</sup>, João Rocha<sup>1</sup>

<sup>1</sup>Instituto Politécnico de Bragança, 5300-253, Bragança, Portugal

(\*)*Email:* [a54152@alunos.ipb.pt](mailto:a54152@alunos.ipb.pt)

### **ABSTRACT**

3D laser scanning ensures consistency and objective validation of results, further increasing the level of quality and advancing problem resolution. Combining the scanner output with auxiliary programs, the scanned images become electronic mockups.

This type of technology allows low-access environments to be integrated into the collection, as well as specific objects, maintaining their integrity and allowing the researcher to work virtually avoiding losses.

Contributing to the guarantee of historic buildings, the study is focused on the development of a new methodology to identify the pathology and assist in the restoration of heritage.

### **INTRODUCTION**

Preventive conservation of cultural heritage refers to the identification of causes or agents that compromise the integrity of the building. In Bragança, the Portuguese city chosen for the study, there are buildings that are over 500 years old, and consequently, there is an urgent need to maintain their properties.

For the documentation of heritage, the use of 3D scanning became coherent. According to Pavlidis (2007), the laser scanner has a great advantage due to the fact that it has a great range, obtaining precision even at a relative distance. This technique allows you to capture fast, direct and accurate measurements of buildings and objects in them.

In order to protect the integrity of the monument and ensure its preservation, this study is focused on the development of a new methodology for the restoration of historic buildings such as museums, theaters and equipment. The information generated in 3D is of significant importance for storing important objects so that everyone has access virtually, preventing the physical from degrading. (REMONDINO, RIZZI, 2010). After scanning and site measurements, these new images will be treated and 3D printed.

### **RESULTS**

Using the Scanner Focus S, the first study environment was the laboratory of the Civil Engineering course at the Instituto Politécnico de Bragança, in which 8 scenes were captured with the help of spheres for the elaboration of 3D images. After processing the images in the Scene Software, as shown in Figure 1, the objective of having the environment virtually was achieved, obtaining the result with an error margin of 1.3 mm. Then, the second environment was raised, being an outdoor area. In this case, the sphere was not used and the recognition of the 12 scenes was done manually. Figure 2 presents an example of a collected image.

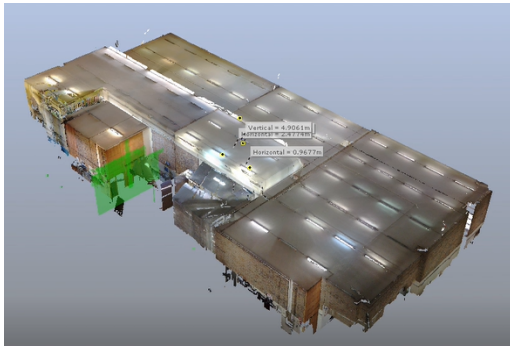


Figure 1- Final scanner result.



Figure 2- Example of image collected by scanner.

## CONCLUSIONS

The results obtained in the two scenes made initially were encouraging. The image generated in 3D is in accordance with the real situation of the environment, requiring small adjustments. New developments are being carried out to improve the methodology already developed.

## REFERENCES

FARO Focus Premium – User Manual. 2022. p. 1-167.

PAVLIDIS, G. et al. Methods for 3D digitization of Cultural Heritage. *Journal of Cultural Heritage* 8: 93-98, 2007.

REMONDINO F, RIZZI. F - Reality-based 3D documentation of natural and cultural heritage sites — techniques, problems, and examples (2010) Trento - Italy.