



Updated syllabus for future NDT masters in France

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■ Introduction

- Many areas of activity : Non-Destructive Testing and Evaluation (NDTE)
- Industry 4.0 is a major challenge in which NDTE have an important role
- Paradoxically, there is little training at the master's or engineer level to train NDTE specialists in France
- There are several universities/engineering schools that offer topics in NDTE

■ Methodology

- Taking advantage of the specificities and skills of each institution
- The ambition of French academic teachers and researchers in NDTE to develop a strong and emerging network
- Examples of Curriculum with NDT parts at the master level

■ Conclusions, discussion and perspective

https://www.ndt.net/article/ecndt2023/papers/ECNDT2023_PRESENTATION_303.pdf

Some NDT news from French media

Industry: “la Nouvelle-Aquitaine “ mobilizes on non-destructive testing To succeed in factory 4.0, the factory of the future, it is essential to master the non-destructive testing of industrial parts.

[La tribune \(2019\)](#)



“Non-destructive testing: professions of the future and more than 1,000 recruitments at Safran”

[hellowork \(2019\)](#)



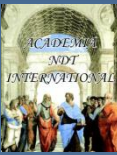
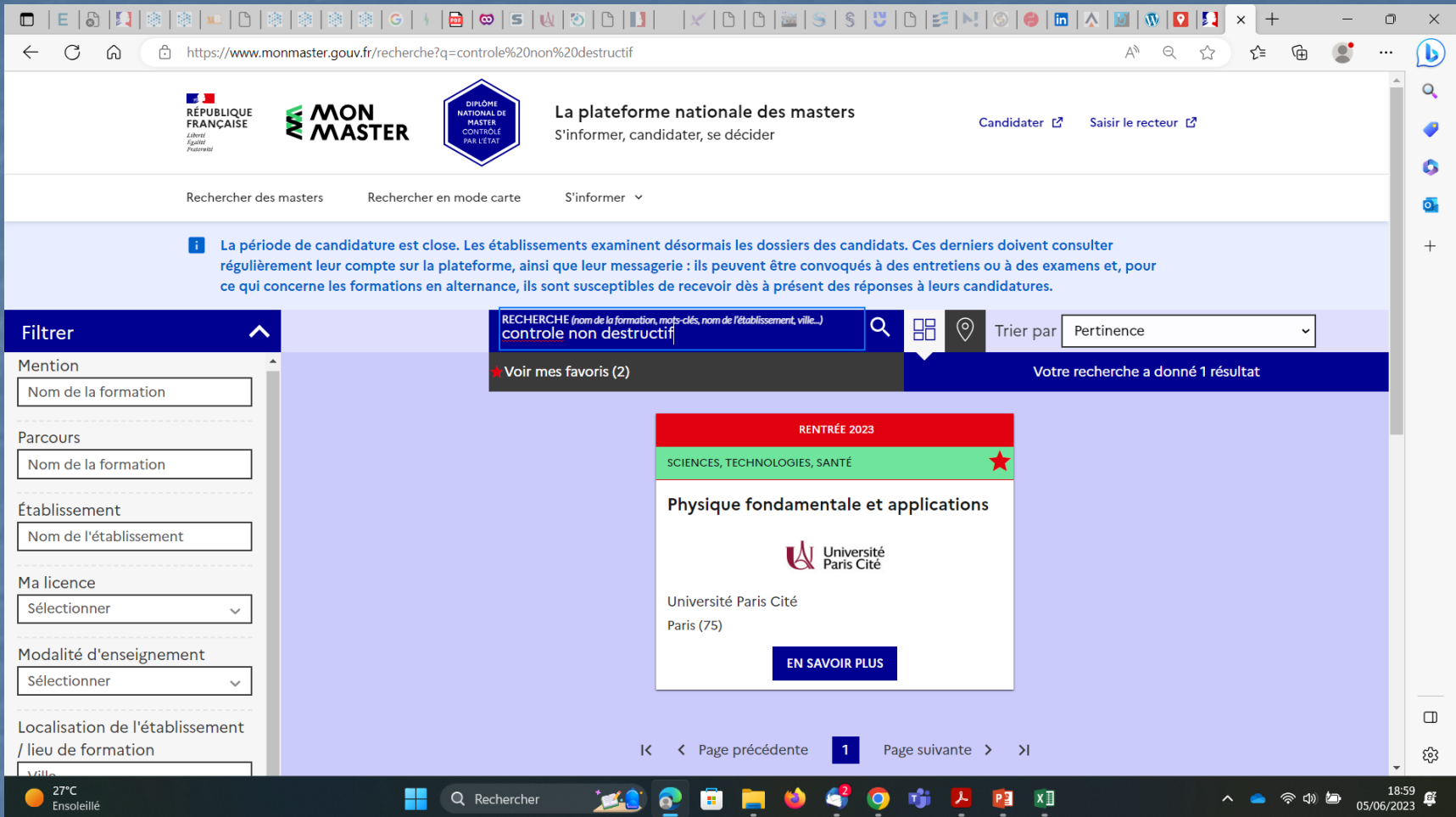
[Usine nouvelle \(2023\)](#)



[Les echos \(2023\)](#)

Nuclear: a non-destructive testing platform inaugurated in Chalon-sur-Saône : A “European nuclear school”

NDT Masters in France

The screenshot shows the MON MASTER website interface. At the top, there are logos for the French Republic, MON MASTER, and the National Diploma of Masters. The main header reads 'La plateforme nationale des masters' with links to 'Candidater' and 'Saisir le recteur'. Below this, a navigation bar includes 'Rechercher des masters', 'Rechercher en mode carte', and 'S'informer'. A blue banner states: 'La période de candidature est close. Les établissements examinent désormais les dossiers des candidats. Ces derniers doivent consulter régulièrement leur compte sur la plateforme, ainsi que leur messagerie : ils peuvent être convoqués à des entretiens ou à des examens et, pour ce qui concerne les formations en alternance, ils sont susceptibles de recevoir dès à présent des réponses à leurs candidatures.'

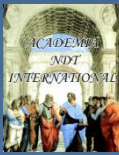
The search bar contains the text 'RECHERCHE (nom de la formation, mots-clés, nom de l'établissement, ville...) controle non destructif'. To the right, there are icons for a grid, a location pin, and a dropdown menu set to 'Pertinence'. Below the search bar, a dark blue bar indicates 'Voir mes favoris (2)' and 'Votre recherche a donné 1 résultat'. The search results show a card for 'RENTÉE 2023' under the category 'SCIENCES, TECHNOLOGIES, SANTÉ'. The specific result is 'Physique fondamentale et applications' at 'Université Paris Cité', located in 'Paris (75)'. A button 'EN SAVOIR PLUS' is visible at the bottom of the card. On the left side, there is a 'Filtrer' sidebar with various filters like 'Mention', 'Parcours', 'Établissement', 'Ma licence', 'Modalité d'enseignement', and 'Localisation de l'établissement / lieu de formation'. The bottom of the page shows a Windows taskbar with the date '05/06/2023' and time '18:59'.

The official French Master portal : no specialized NDT Master Training !

<https://www.monmaster.gouv.fr/>



Masters with NDT topics



1. École Nationale Supérieure de Techniques Avancées (ENSTA ParisTech) - Mastère Spécialisé (MS) en Contrôle Non Destructif et Mesures Industrielles. Site web : <https://www.ensta-paris.fr/>
2. Université de Technologie de Compiègne (UTC) - Master Recherche en Mécanique, spécialité Contrôle Non Destructif. Site web : <https://www.utc.fr/>
3. Université Paris-Est Créteil (UPEC) - Master Professionnel Contrôle Qualité et Non Destructif (CQND). Site web : <https://www.u-pec.fr/>
4. Institut National des Sciences Appliquées (INSA) Lyon - Master Recherche en Mécanique, spécialité Contrôle Non Destructif. Site web : <https://www.insa-lyon.fr/>
5. École Supérieure des Techniques Aéronautiques et de Construction Automobile (ESTACA) - Mastère Spécialisé en Contrôle Non Destructif. Site web : <https://www.estaca.fr/>
6. Université de Bourgogne - Master Professionnel Procédés, Contrôle et Matériaux Métalliques: Industrie du Nucléaire (PC2M). CND en alternance. Site web : <https://blog.u-bourgogne.fr/master-pc2m/>
7. Université de Nantes - Master Recherche en Sciences et Techniques, spécialité Contrôle Non Destructif et Mesures. Site web : <https://www.univ-nantes.fr/>
8. Université de Lorraine - Master Recherche en Mécanique, spécialité Contrôle Non Destructif. Site web : <https://www.univ-lorraine.fr/>
9. Université de Technologie de Troyes (UTT) - Master Recherche en Sciences et Technologies, spécialité Contrôle Non Destructif et Fiabilité des Matériaux. Site web : <https://www.utt.fr/>

Masters with NDT topics

9. Institut National Polytechnique de Toulouse (INPT) - Master Recherche en Mécanique, spécialité Contrôle Non Destructif et Mesures. Site web : <https://www.inp-toulouse.fr/>
10. Université de Technologie de Belfort-Montbéliard (UTBM) - Master Recherche en Mécanique et Energétique, spécialité Contrôle Non Destructif. Site web : <https://www.utbm.fr/>
11. Université Claude Bernard Lyon 1 - Master Recherche en Sciences et Technologies, spécialité Contrôle Non Destructif des Matériaux et Structures. Site web : <https://www.univ-lyon1.fr/>
12. Université de Lille - Master Recherche en Sciences de l'Ingénieur, spécialité Contrôle Non Destructif. Site web : <https://www.univ-lille.fr/>
13. Institut Supérieur de Mécanique de Paris (ISMEP) - Master Recherche en Sciences et Génie des Matériaux, spécialité Contrôle Non Destructif et Intégrité des Structures. Site web : <http://www.ismep.fr/>
14. Université de Strasbourg - Master Recherche en Physique, spécialité Contrôle Non Destructif. Site web : <https://www.unistra.fr/>
15. Université de Bordeaux -Le Coursus Master en Ingénierie IMSAT (Ingénierie et Maintenance des Systèmes pour l'Aéronautique et les Transports) ; <https://evering.u-bordeaux.fr/Nos-formations/Cursus-Master-en-Ingénierie-IMSAT>
16. École d'ingénieur POLYTECH Dijon-Ex ESIREM – Formation ingénieur en alternance sur 3 ans Matériaux et Contrôle Non Destructif (Ouverture septembre 2023) Site web : <https://esirem.u-bourgogne.fr/wp-content/uploads/2023/04/cnd.pdf>

Examples

1. Lyon (Open NDE)
2. Le Mans (ECND Academy)
3. Blois (NDT Integrity Engineering)
4. Dijon (Material Engineering and NDT)
5. Paris Sorbonne university/Abu Dhabi
(Specialization in Non-Destructive Characterization with
Applications for Cultural Heritage)

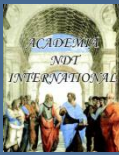
1. Lyon (Open NDE)

Engineer level NDT training

Goal : train students with a cross-disciplinary vision of NDT without being specialists in all NDT methods

- Program elaboration in concertation with industrials
- Well balanced program between industrial and academic
- Experimental activities ratio : 30 %
- Training specialized on NDT :
 - All methods/technics
 - Materials (metal, ceramic, composites, ...) and manufacturing process (welding, casting, additive manufacturing)
 - Data analysis (simulation, IA, ...)

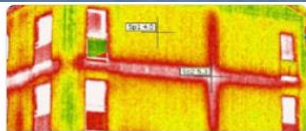
1. Lyon (Open NDE)



Moodle dedicated platform for NDE courses

➤ <https://moodle.opennde.org/>

Some topics



Thermographie infrarouge
Méthodes CND volumiques



Tomographie par rayons X
Méthodes avancées en CND



Traitement du signal et de l'image,
...
Analyse et exploitation des donn...



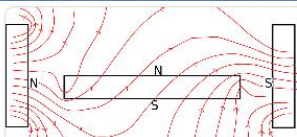
POD, fusion de données,
contrôlabilité
Analyse et exploitation des donn...



Problème inverse
Analyse et exploitation des donn...



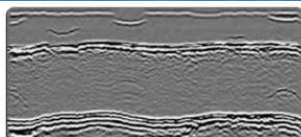
Projet Matériaux
Matériaux et CND



Magnétoscopie
Méthodes CND surfaciques



Méthodes électromagnétiques
avancées
Méthodes avancées en CND



Méthodes ultrasoniques avancées
Méthodes avancées en CND



Méthodes visuelles avancées
Méthodes avancées en CND

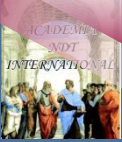


Normalisation
Introduction aux CND



Passeport numérique
Analyse et exploitation des donn...

1. Lyon (Open NDE)

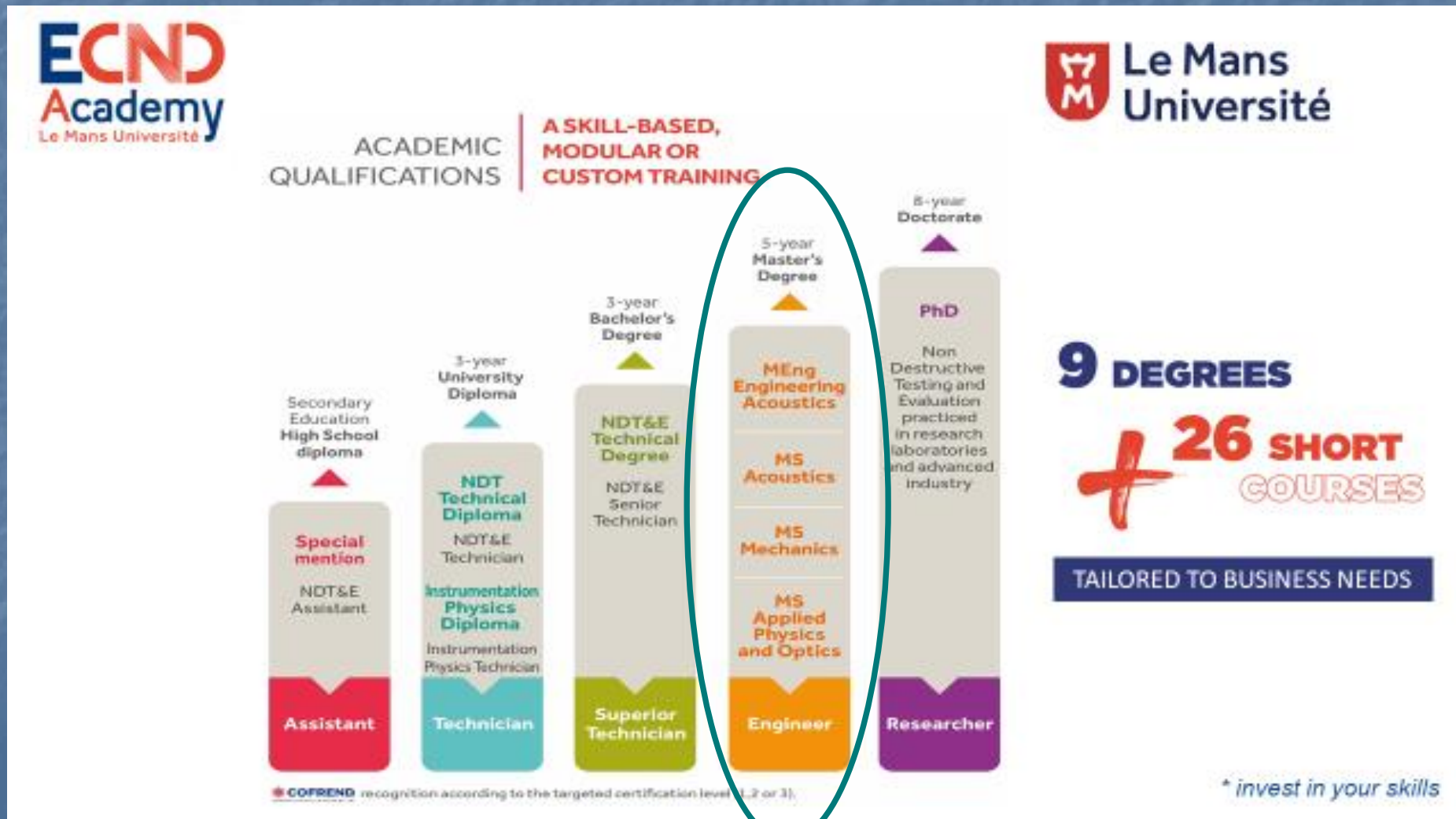


Companies involved

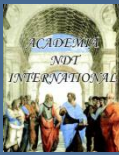


2. Le Mans (ECND Academy)

NDT Master@Le Mans université



3. Blois (INSA Centre Val de Loire)



NDT topics : NDT Integrity Engineering



DUNAÚJVÁROSI EGYETEM
UNIVERSITY OF DUNAÚJVÁROS



NDT Integrity Engineering – A New Profession Part 2: Non-destructive testing

Peter Trampus
professor emeritus
trampus@uniduna.hu

„Non-Destructive Testing” Course, INSA, France
November 16-17, 2020



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MASTER

MASTER'S DEGREE IN APPLIED PHYSICS AND PHYSICS ENGINEERING (SEPT. 2023)

 Application Form  Presentation

The Master's degree in fundamental physics "Applied Physics - Electronics, Electrical Energy and Automation", (M2R3 EA), is evolving and becoming the **Master's degree in Applied Physics and Physics Engineering**. It will open in September 2023.

The Master addresses students interested in disciplines oriented toward applied physics and engineering sciences in the fields of electronic systems and components, instrumentation and ultrasounds, automatic, robotics and computer vision. It is also intended for students interested in the design of renewable energy systems. Students take scientific courses in applied mathematics and computer science, electronics, signal processing, automatic, instrumentation, ultrasound, etc., as well as in the behavior of organizations, scientific communication and professional English or French for foreign students. At the end of the Master 1, students can join one of the two Master 2 tracks of the master: Electronics, Instrumentation and Ultrasound for the first track, and Automatic Robotics and Computer Vision for the second one.

- TO RECEIVE YOUR DEGREE
- THE SPORTS/STUDIES PROGRAMME AND HIGH-LEVEL SPORTS SECTION
- SCIENCES AND TECHNIQUES FOR ENGINEERS
- INDUSTRIAL RISK CONTROL
- COMPUTER SECURITY AND TECHNOLOGIES
- INDUSTRIAL SYSTEMS ENGINEERING
- ENERGY RISKS AND THE ENVIRONMENT

<https://www.insa-centrevaldeloire.fr/en/training/master>

4. Dijon (Polytech Dijon)



Material Engineering and NDT

<https://esirem.u-bourgogne.fr/wp-content/uploads/2023/04/cnd.pdf>

New: opening September 2023

APPRENTISSAGE




Ingénieur Matériaux
 option Contrôle Non Destructif





- Engineering degree (Master level)
- 3-year apprenticeship with a company

Content :

- Extensive training in material science
- About 225h of training in NDT
- Engineering science & advanced tools

(Specialization in Non-Destructive Characterization with Applications for Cultural Heritage)

Master in Physics with NDT topics



Contact: valerie.leguyon@sorbonne.ae

Dr Valerie Le Guyon – Head of the Sciences and Engineering Department

Master in Physics

- 2-year program (including a 6-months internship) - taught in English
- Designed with the Lab. d'Archeologie Moleculaire et Structurale - Sorbonne Universite
- Degree awarded by Sorbonne Universite

Innovative program to educate highly skilled NDT scientists,
exposed and trained to multi-disciplinarity.

**Master in Physics:
Specialisation in
Non-Destructive
Characterisation with
Applications for Cultural
Heritage**

Master topics

Theoretical courses (about 50%)

- ✓ Quantum and Statistical Physics, Material Science, Atomic and Molecular Physics, Vibrations and acoustics
- ✓ Heritage Science, Ethics, Scientific computing, Big Data and Artificial Intelligence
- ✓ Fields of application for NDT: space science, forensics, industry, authentication, quality control, etc

Hands-on & Project-related courses (about 50%)

- ✓ Lab sessions on specific techniques
- ✓ Small projects on the analysis of cultural heritage artefacts
- ✓ Long project run with Archaeology students, on an archaeological site in the UAE
- ✓ 6-month full time internship & Master thesis, in the UAE or abroad, in an academic lab or in a company, in fields applying NDT

<https://www.sorbonne.ae/study/postgraduate-study/master-in-physics-specialisation-in-non-destructive-characterisation-with-applications-for-cultural-heritage/>

Faculty members

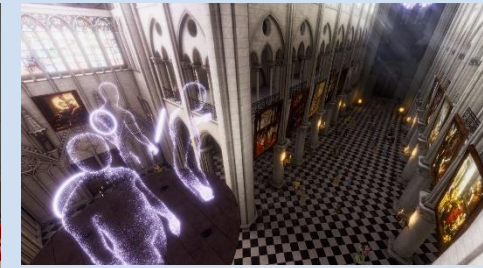
Dr Stavros Christopoulos – Physics / Atomic, molecular and optical physics - **Dr Joumana ElRifai** – Engineering / MicroElectronics Mechanical systems - **Dr Delphine Syvilay** – Physics and Heritage Science - **Dr Omar El Dakkak** – Mathematics / Statistics and Probability - **Dr Samuel Feng** – Applied and Computational Mathematics - **Dr Christophe Moulherat** – Heritage science / Specialist in Textiles - **Pr Maguy Jaber** – Director of the LAMS – Sorbonne Universite - **Dr Philippe Walter** – LAMS – Directeur de recherche CNRS

Current projects:

Heritage Science

- ✓ Face veils
- ✓ Al Sadu: traditional weaving techniques
- ✓ UAE archaeological artefacts
- ✓ Dutch ceramics from ships wreckage
- ✓ Development of 3D scans and holographic images
- ✓ Application of Virtual reality in heritage science

Notre-Dame de Paris: Immersion into an extraordinary restoration



Fabrication of samples by diffusion of nanoparticles or nano-printing:



Material Science

- ✓ Smart optical films
- ✓ Nanostructured layers for energy harvesting
- ✓ Electrocaloric effect in liquid crystals
- ✓ Nano-diffusion or nano-printing

Mobile Heritage Science Lab:

A unique set of portable instruments in the region:
Raman, UV-vis-IR, FTIR, hyperspectral, RX, XRF, Ultrasound, 3D scanner, ...



A few images

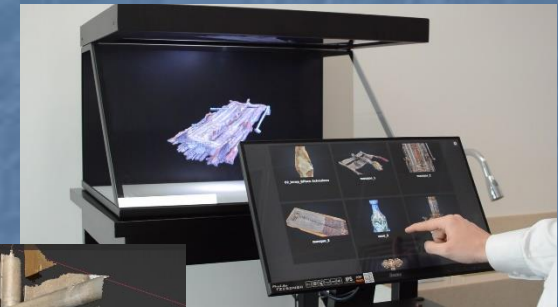
Textiles: Face veils



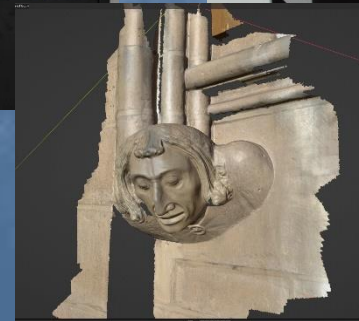
High definition 3D digital microscope



Holographic tables

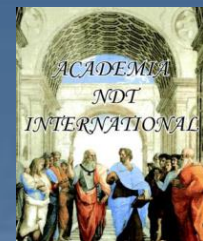
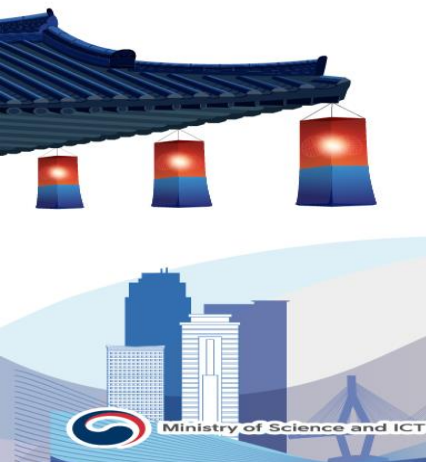


Traditional weaving techniques



Conclusion and perspectives

- Highlight the NDT needs and federate **different actors** (industrials/academics) **within the AI ecosystem**
- Provide strong actions to **national bodies in France** in order to increase the visibility of NDTE within finances
- Define actions closely to **students** using international organizations (European Union, IEEE UFFC, etc.)



Thank you !
Questions ?

