



HAL
open science

Transfer Learning to close the gap between experimental and numerical data

Hadrien Postorino, Eric Monteiro, Marc Rebillat, Nazih Mechbal

► To cite this version:

Hadrien Postorino, Eric Monteiro, Marc Rebillat, Nazih Mechbal. Transfer Learning to close the gap between experimental and numerical data. ICCBMA22 (1st International Conference for CBM - Condition-Based Maintenance - in Aerospace) 24-25 May 2022, May 2022, Delft, Netherlands. ⟨hal-03991319⟩

HAL Id: hal-03991319

<https://hal.science/hal-03991319v1>

Submitted on 15 Feb 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization

Title	Transfer Learning to close the gap between experimental and numerical data
Author keywords	Transfer Learning Optimal Transport Deep learning Convolutional Neural Network Lamb Wave
Topics	Structural Health Monitoring, TS - Operational Monitoring using Airframe Digital Twins in Aerospace
Abstract	<p>The deployment of Deep Learning (DL) strategies is particularly advantageous in Structural Health Monitoring (SHM) based of lamb Wave (LW) propagation due to the high quantity of data collected by the network of piezoelectric transducers (PZT) during all the life cycle of the composite structure. However, such strategies rely on large training databases, difficult to collect experimentally. The use of numerical simulations faces that issue, but the models never fit perfectly to the real structures, leading to error of diagnostic.</p> <p>We propose here to use Transfer Learning (TL) approaches to reduce the predictions errors of a Convolutional Neural Network (CNN) trained with numerical data. The network predicts the size and the position of a damage on a composite plate equipped with PZT. It is trained on a large source database composed of different damage scenarios on a composite plate. A second smaller target database is generated with small variations on the mechanic properties and PZT positions to simulate manufacturing uncertainties. Those uncertainties lead to prediction errors of the CNN. A Domain Adaptation (DA) based on Optimal Transport (OT) is used to project the target data on the source domain and therefore reduces the predictions error of the CNN. These TL approach should allow us to close the gap between experimental and numerical data.</p>

Authors							
first name	last name	email	country	affiliation	Web page	corresponding?	presenter
Hadrien	Postorino	hadrien.postorino@ensam.eu	France	PIMM, Arts et Metiers Institute of Technology, CNRS, Cnam,		✓	✓

Eric	Monteiro	eric.monteiro@ensam.eu	France	HESAM University PIMM, Arts et Metiers Institute of Technology, CNRS, Cnam, HESAM University		
Marc	Rebillat	marc.rebillat@ensam.eu	France	PIMM, Arts et Metiers Institute of Technology, CNRS, Cnam, HESAM University		
Nazih	Mechbal	nazih.mechball@ensam.eu	France	PIMM, Arts et Metiers Institute of Technology, CNRS, Cnam, HESAM University		