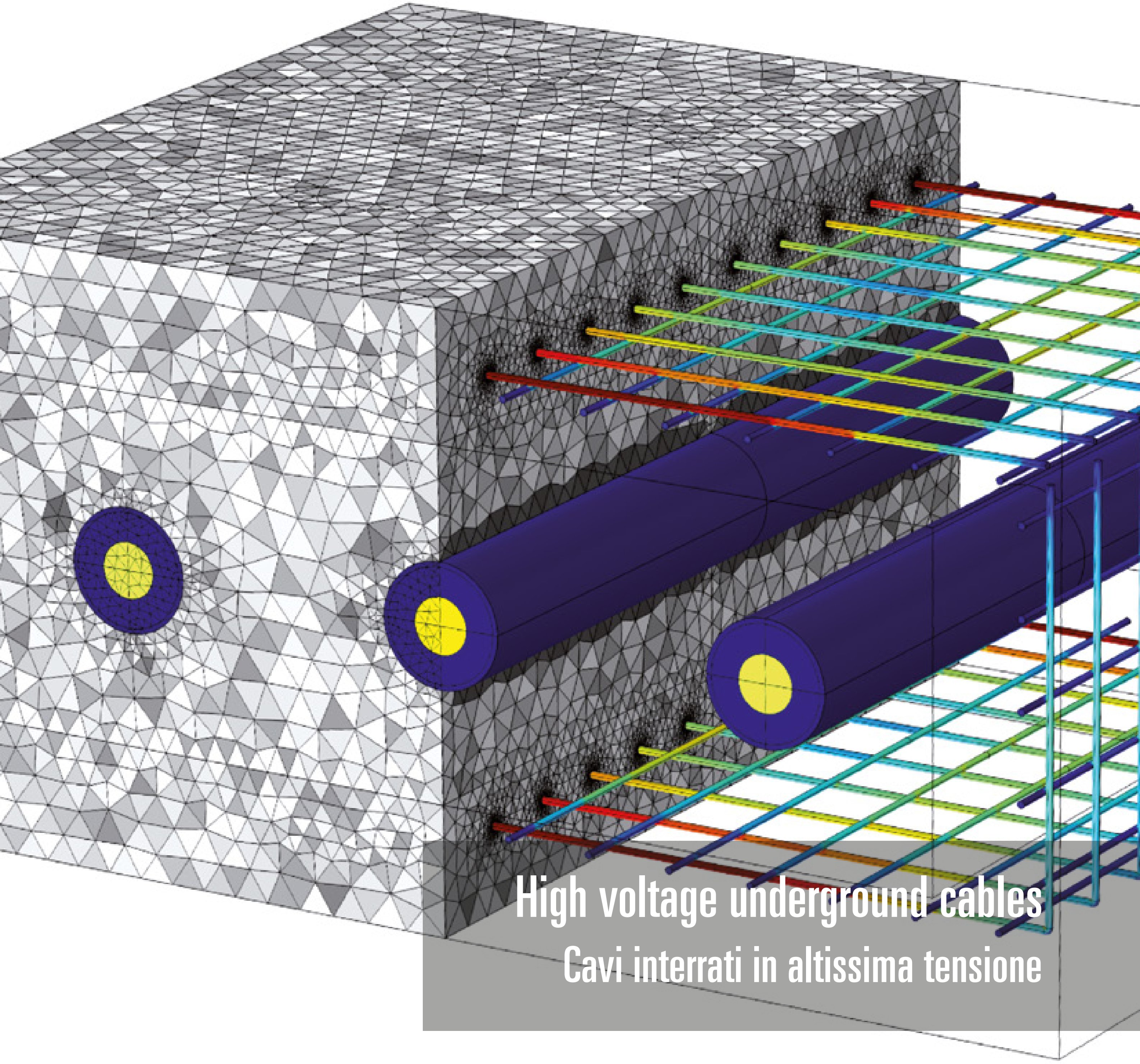
DIINFORMA

1.06

MAGGIO 2020

NEWSLETTER DEL DIPARTIMENTO DI INGEGNERIA INDUSTRIALE DELL'UNIVERSITÀ DEGLI STUDI DI PADOVA



High voltage underground cables

Cavi interrati in altissima tensione

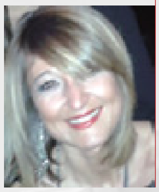
DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

800 ANNI 1222·2022

UNIVERSITÀ DEGLI STUDI DI PADOVA

Introduzione

Stefania Bruschi, Direttore del Dipartimento di Ingegneria Industriale



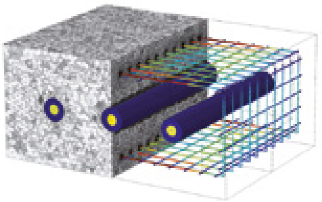
È con grande piacere che introduco questa edizione di DIInforma, la prima dopo la mia elezione a Direttore del Dipartimento di Ingegneria Industriale. Fin dalla fondazione del Dipartimento a inizio 2012, su iniziativa dell'allora Direttore prof. Andrea Stella, si sono susseguiti diversi numeri del DIInforma che hanno consentito di dare un quadro snello ma esaustivo delle attività di ricerca condotte presso i nostri laboratori con articoli a firma non solo dei docenti del dipartimento ma anche di giovani ricercatori che si sono via via affacciati al mondo della ricerca.

Negli anni il DIInforma ha consentito non solo di promuovere le nostre attività verso l'esterno, ma ci ha anche consentito di stringere nuove collaborazioni al nostro interno, portando all'avvio di nuove tematiche di ricerca, nobilitate dall'interdisciplinarietà che contraddistingue il nostro dipartimento.

Non posso non fare riferimento al periodo difficile che stiamo vivendo a seguito dell'emergenza COVID-19. A partire da marzo stiamo erogando didattica esclusivamente per via telematica, e questa riconfigurazione è stata attuata in tempi strettissimi. Nei mesi di marzo e aprile i nostri laboratori di ricerca sono stati praticamente chiusi, per ottemperare alle disposizioni di contenimento. Questo ha sicuramente rallentato le attività di ricerca di un dipartimento che ha una spiccata vocazione sperimentale testimoniata dalle decine di laboratori sperimentali distribuiti nelle diverse sedi del dipartimento. Ma dal 4 maggio le attività di ricerca nei laboratori sono riprese, seppure in modo molto graduale per garantire le regole di distanziamento fisico. Abbiamo vissuto e stiamo tuttora vivendo un momento veramente unico e particolare. Tuttavia, per quanto questo ha avuto ed avrà un impatto sulle nostre attività, sono convinta che questo periodo ci ha consentito momenti di riflessione a tutti i livelli, ivi compresa la nostra ricerca, con la consapevolezza che siamo comunque in grado di ripartire con la forte motivazione che sempre ci contraddistingue.

Questa edizione del DIInforma vede pubblicati 8 contributi che spaziano nelle diverse tematiche di ricerca del dipartimento, dai sistemi meccanici e elettrici ai materiali alla mobilità sostenibile ai processi/prodotti per terminare con la sicurezza ambientale e industriale.

Ringrazio tutti coloro che si adoperano per la pubblicazione del DIInforma, in particolare la Commissione Comunicazione e Immagine di dipartimento e i colleghi che contribuiscono con le loro testimonianze. Infine, un ringraziamento particolare ai nostri giovani collaboratori, che giorno dopo giorno si impegnano in prima persona a condurre le attività di ricerca con grande passione.



C O P E R T I N A

Cavi interrati in altissima tensione protetti da una struttura in cemento armato
High voltage underground cables protected by a reinforced concrete structure

PAGINA

DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

Ingegneria dei sistemi elettrici

Electric engineering systems

DII research group
EdLab
Elecrtic Drive Laboratory

Silverio Bolognani
silverio.bolognani@unipd.it
+39 049 827 7509

Nicola Bianchi
nicola.bianchi@unipd.it
+39 049 827 7593

Luigi Alberti
luigi.alberti@unipd.it
+39 049 827 7508

Diego Troncon
diego.troncon@phd.unipd.it

http://edlab.dii.unipd.it/

This research is developed within the frame of the project «Green SEED: Design of more-electric tractors for a more sustainable agriculture» founded by the Italian Ministry of Research and University with the grant 2017SW5MRC, 2017 call. PI of the project: prof. Luigi Alberti

Main research topics:

- Design of electrical drives
- Design of electrical machines
- More electrical vehicles
- Green power conversion

Design of more-electric tractors for a more sustainable agriculture

In the recent years, the attention toward electrification of non-road mobile machinery is increasing, in particular for those machinery involved in construction and agriculture application. The interest is raised also for the introduction of a more strict regulation for vehicles, which requires lower emission and higher efficiency.

Specialized tractors are a particular category belonging to agriculture tractors, involved in vineyard and orchard applications. The limited dimensions of the crops set strict constrains for width and height of specialized tractors, this is often in contrast with the high power required by heavy applications and it make challenging the electrification.

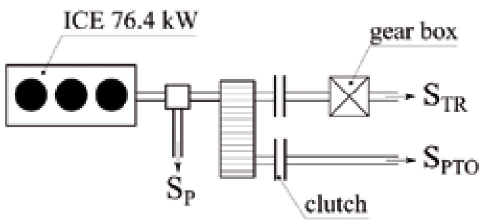
These machineries are involved in a wide variety of operations with different intensity, therefore the interest for the electrification is raised.

In the hybrid configuration, combining the internal combustion engine and the electric motor, heavy operations are fulfilled with a better efficiency. On the other side, light operations could be fulfilled in pure electric mode. The latter case brings interesting benefits, for example the reduction of local emissions on crop field or inside greenhouses, as well as the reduction of noise and vibration improving comfort and health of operators.

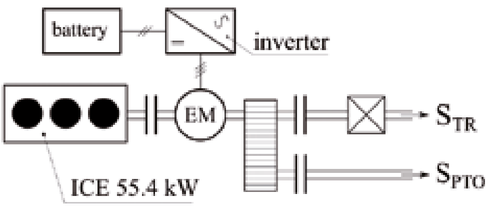
In road-vehicle category the research is already at an advanced stage, including approved models useful for sizing the system and well known driving cycles.

In case of agriculture tractor, the traction is only a limited part of the machine, the power required by the power take-off for implements and by the pump for hydraulic circuits has to be considered, which make more complex the vehicle model. Moreover, in such an application working cycles are not that trivial and then the system design is not straightforward. The research focus is mainly on the electric system sizing and design.

Example of a specialized agriculture tractor for vineyard or orchard applications.
Typical dimensions for such a vehicle:
width 1600 mm,
height 2400 mm,
length 4000 mm.



Traditional powertrain architecture



Hybrid powertrain architecture.

Effect of additive manufacturing induced anisotropy on machinability of Ti6Al4V parts

Additive Manufacturing (AM) processes are increasingly used to produce complex shape metal components in many industries thanks to the advantages they offer in terms of component customization. Due to the poor surface quality of AM parts, some finishing machining operations may be required to achieve the desired geometrical constraints and surface finish.

However, cutting processes may be influenced by their peculiar microstructure. The multiple thermal phenomena taking place during the AM process give rise to a microstructural anisotropy: columnar grains form along the part growth direction. The main input of this research for the understanding of the effect of the AM-induced anisotropy on the machinability is the evaluation of the tool wear when milling Ti6Al4V blocks obtained via laser powder bed fusion, with horizontal and vertical development. The cutting tool that machined the horizontally oriented (HO) sample showed a tool life 66% higher than the one that machined the vertically oriented (VO) one (Figure 1). The correlation between the growth orientation of AM parts and their machining response should be solely attributed to the samples' microstructure.

After the heat treatment, which is necessary to stabilize the microstructure, several discontinuity zones (α phase layers) form along the boundaries of the columnar grains, and they are known to act as preferential paths of fracture. It has been found that these weak zones help material removal during cutting when favorably oriented compared to the cutting edge of the cutting tool. In fact, in the HO sample, the α phase layers are parallel to the main cutting edge of the tool (Figure 2), whereas in the VO sample, they are orthogonal to the cutting edge, resulting irrelevant in the cutting process.

This study showed that the best machining performances are assured when cutting the surfaces perpendicular to the growth direction, representing a step forward into the interpretation of the AM parts machinability.

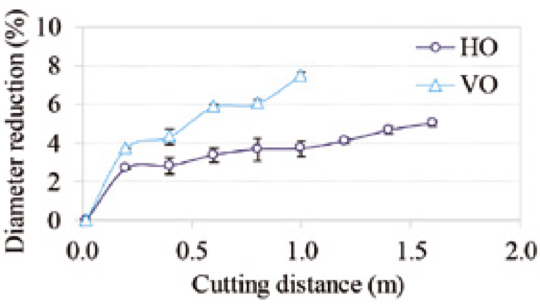


Fig. 1. Reduction of the tool diameter as a function of the cutting distance.

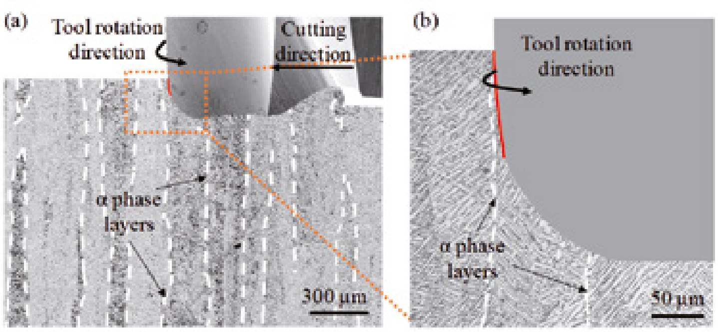


Fig. 2. Orientation of the main tool cutting edge (in red) with respect to the columnar grains for the HO sample (a), and zoomed picture showing the α phase layers position relative to the main cutting edge.

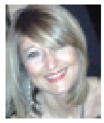
Ingegneria dei sistemi meccanici

Mechanical systems

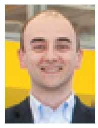
DII research group
Precision Manufacturing Engineering

Lucia Lizzul, PhD student
lucia.lizzul@phd.unipd.it

Supervisor:
Stefania Bruschi



Stefania Bruschi
stefania.bruschi@unipd.it
Phone: +39 049 8276821



Andrea Ghirotti
andrea.ghirotti@unipd.it
Phone: +39 049 8276822

http://www.labtesi.dii.unipd.it/

Testo collaborazioni e progetti:

This research activity has been carried out thanks to the collaboration of the Italian company SISMA S.p.A., which manufactured the AM samples sharing their precious experience and Sandvik Italia S.p.A., which provided the tools and technical support.

Main research topics:

- Main research topics:
- Manufacturing systems and processes
- Micro-technologies and precision technologies
- Shaping of metallic materials
- Processing of polymeric materials
- Geometric metrology

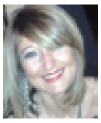
Ingegneria dei sistemi meccanici

Mechanical systems

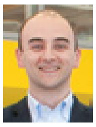
DII research group
Precision Manufacturing Engineering

Tommaso Magro, PhD Student
tommaso.magro.1@phd.unipd.it

Supervisor
Andrea Ghiotti



Stefania Bruschi
stefania.bruschi@unipd.it
Phone: +39 049 8276821



Andrea Ghirotti
andrea.ghirotti@unipd.it
Phone: +39 049 8276822

http://www.labtesi.dii.unipd.it

Collaborazion e progetti:

This work was carried out as a part of the Italian Research Program PRIN 201742RB8R of the Ministry of University and Scientific Research and of the project BIRD195839 of the University of Padova.

Main research topics:

- Main research topics:
- Manufacturing systems and processes
- Micro-technologies and precision technologies
- Shaping of metallic materials
- Processing of polymeric materials
- Geometric metrology

Severe Plastic Deformation by incremental processes

Nowadays, metal prostheses can be designed for permanent implantations (such as dental prostheses, knees, hips, etc.) or to supply just a temporary supporting function (e.g. for fixing bone fractures). Being fundamental for the correct tissue healing, the unsolved drawback that temporary devices present is the need of addition surgery for their removal from the human body, with negative effects for the patients' well-being and additional costs for the healthcare.

From this standpoint, bioabsorbable prostheses, that is parts characterized by a temporarily service-life and capable to be independently eliminated by the human body, would represent a solution as effective for the patients' quality of life as difficult to industrialize. In the last decade several attempts were made by researchers to manufacture bioresorbable prostheses, but all the potentially interesting metallic alloys seems to suffer of poor mechanical properties or poor chemical resistance. Zinc can be considered an emblematic case, since it is not harmful and present a suitable corrosion resistance in human body, but, at the same time, it has extremely poor mechanical properties that make it unsuitable for any application.

Severe Plastic Deformation (SPD) processes (see examples in Fig. 1), which allow forming parts with extremely refined microstructure and quite complex part shapes, can theoretically offer a practicable solution to these limits. In fact, the extremely high material deformation rates applied under complex stress states and high hydrostatic pressure return final microstructures with average sizes below 1 μm that allow increased mechanical characteristics of the final parts.

The aim of the project is to explore the potentialities of these SPD techniques to manufacture components with a significant grain refinement (below 1 μm) when applied to pure zinc alloy in order to increase its mechanical resistance to values suitable for temporary prostheses. Preliminary analyses have shown that using SPD processes the grain size of a pure zinc alloys (see microstructures in Fig. 2) varies from 300 μm up to 10 μm, with an increase in the microhardness of the sample and, consequently, also in the mechanical properties of the material.

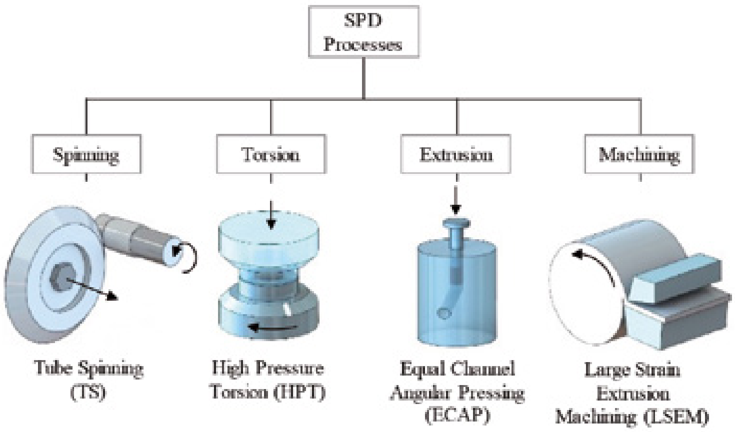


Figure 1 . Sketches of forming- and machining-based SPD processes.

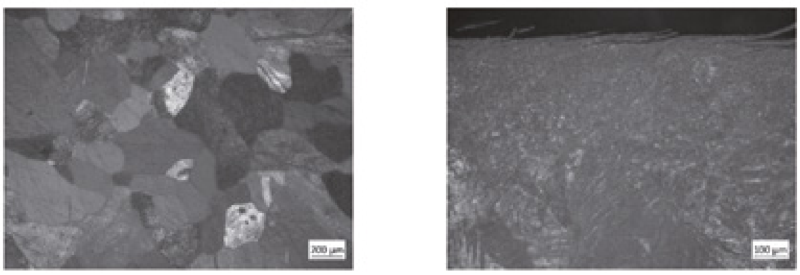


Figure 2 . Zinc alloy microstructure before (left) and after (right) the SPD process.

Complex SiOC ceramics from 2D structures by 3D printing and origami

Additive manufacturing of preceramic polymers to fabricate 3D polymer derived ceramics (PDCs) has recently attracted a lot of interest, with researchers employing a wide range of technologies for the production of ceramic components. However, the inherent brittleness and high hardness of ceramics after pyrolysis, resulting from their ionic or covalent bond still limits their further reconfiguration toward more intricate shapes.

The alternative is performing the reconfiguration to the selected flexible green body before the pyrolysis. To this end, a kind of silicone preceramic which is flexible after cross-linking was selected as the ink for the direct ink writing in this work. Furthermore, Origami, the ancient art of paper folding, was employed to achieve the secondary reconfiguration of printed parts toward the further complexity of ceramic architecture, in the consideration of the possibility of creating complex three-dimensional structures starting from two-dimensional patterns fabricated by direct ink writing.

Specifically, two approaches were adopted: (I) Filament-assisted origami: silicone filaments (made from the same silicone material) to keep the completely cross-linked printed sheets in shape during pyrolysis and could be removed after pyrolysis without damaging the folded patterns. (II) Self-adhesive origami: considering the self-adhesion of the printed sheets after half cross-linking, the folded structures could maintain their shape by manually applying a light pressure without using a filament. Obviously, not having to use a wire to bind the sides of the sheets nor having to eliminate it after pyrolysis greatly simplifies the fabrication of complex architectures.

Based on those approaches, the spiral, flower-like and polyhedron architectures, which are difficult to fabricate without adding supports or by any conventional ceramic fabrication processes. Produced samples showed no cracks or pores and fully retained the given shape after pyrolysis.

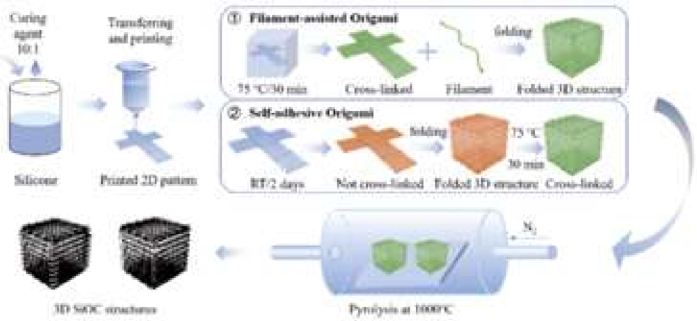


Diagram of fabrication

Filament-assisted origami

Self-adhesive origami

The complex structures: bow tie, dodecahedron, flower

Materiali

Materials

DII research group
Advanced Cearmic and
Glass research group

Paolo Colombo
paolo.colombo@unipd.it
Phone: +39 0498275825

Giorgia Franchin
giorgia.franchin@unipd.it
Phone: +39 0498275508

Assisted by
Kai Huang, *PhD student*
Hamada Elsayed, *post-doc*

https://research.dii.unipd.it/ceramglass/

Main research topics:

- Nanostructured ceramic composites from preceramic polymers and fillers
- Advanced porous ceramic components
- Bioceramics from innovative formulations and processes
- Monolithic and cellular glass and glass-ceramics
- Innovative building materials from inorganic waste
- Additive manufacturing of porous and dense ceramic components

Materiali
Materials

DII research group
Machine Design

Giovanni Meneghetti
giovanni.meneghetti@unipd.it
Phone: +39 049 8276751

Daniele Rigon
daniele.rigon.1@phd.unipd.it
Phone: +39 049 8276828

Claudio Gennari
claudio.gennari@phd.unipd.it
Phone: +39 049 8275498

https://www.dii.unipd.it/costrmac

Main research topics

- Development of numerical and experimental methods to evaluate the structural durability of mechanical components and structures
- Static mechanical characterization and fatigue of metallic and polymeric materials
- Development of local approaches for structural analysis and fatigue design of components and structures weakened by defects and notches

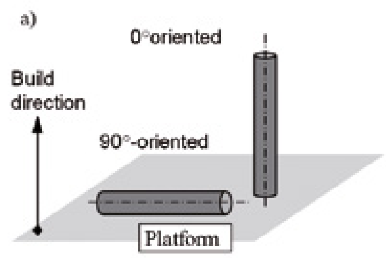
Influence of defects on axial fatigue strength of maraging steel specimens produced by additive manufacturing

The research is focused on axial fatigue strength of Selective Laser Melting (SLM)-processed parts, which are affected by Lack Of Fusion (LOF) defects having irregular 3D shape. Tension-compression fatigue test were performed on maraging steel 300 (or 18Ni-300) specimens, which have been additively manufactured at 0° as well as at 90° with respect to the building direction (see fig.1a).

A certain scatter of the fatigue test results was obtained (see fig.1b) and the reason for that behavior was investigated by means of scanning electron microscopy analysis of the fracture surfaces. In all the samples, LOF defects of different dimensions were found, the biggest cluster of them being the responsible for fatigue failure (see fig.2a).

Dealing with short crack-like defects, the El-Haddad- Smith-Topper material length parameter a0 was evaluated by means of a novel approximate method, which basically consists in matching two models, i.e. the Murakami threshold SIF model and the El-Haddad- Smith-Topper (fig. 3a). The advantage of this engineering approach is that only Vickers hardness of the material is necessary (fig. 2b).

Finally, the short-crack SIF ΔK of the killer defect was adopted as a fatigue damage parameter and consequently the scatter indexes (Ts) of the results on 0°- and 90°-oriented specimens were reduced of 10% and 18%, respectively (fig.3b).



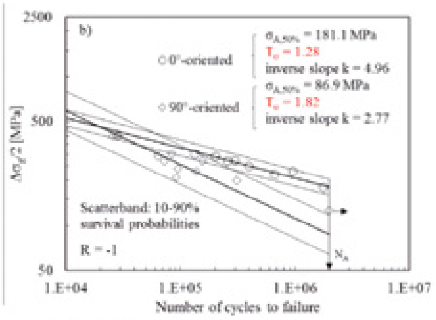


Fig.1 – a) specimens orientation; b) fatigue test result in terms of nominal stress amplitude

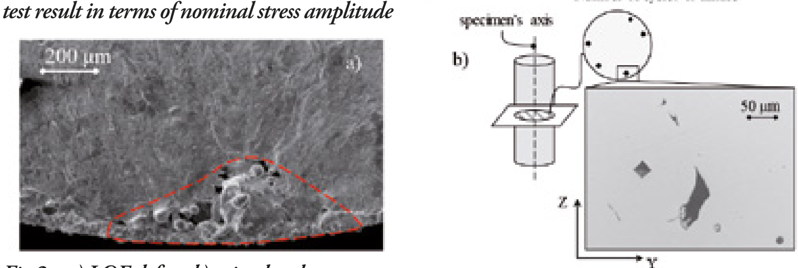


Fig.2 – a) LOF defect; b) microhardnessmeasurements

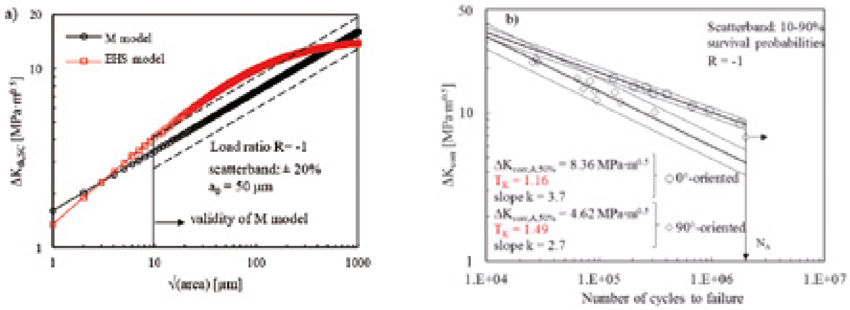


Fig.3 – a) Murakami threshold SIF model (M model) and the El-Haddad-Smith-Topper model (EHS model); b) fatigue test result in terms of ΔK for short cracks

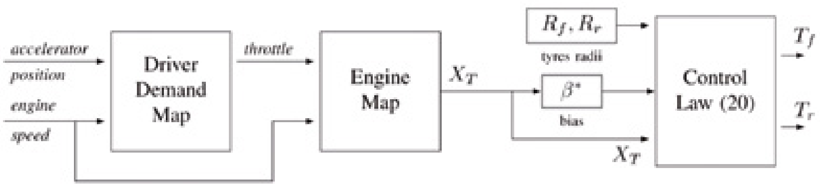
An electric all-wheel drive motorcycle for a safer and greener mobility

Modern mobility requires urgent solutions regarding the problems of pollution, congestion, and safety. Powered two-wheeled vehicles are advantageous compared to cars in terms of reduced energy consumption, lower polluting emissions, and smaller size. On the other hand, two-wheelers are the most exposed to road accidents and their safety must be enhanced.

Our contribution consists in the improvement of stability and handling of a small motorcycle, which is designed for personal mobility and off-road recreational use. The vehicle powertrain was designed and prototyped by Visionar srl and includes two electric motors: one is mounted on the chassis and drives the rear wheel like in a traditional motorcycle, the second one is mounted directly on the front wheel hub. This all-wheel drive architecture can potentially improve traction under acceleration and in cornering, but only if front and rear wheel torque are properly balanced.

We analysed this problem and identified the law of optimal distribution between wheel torques, which depends on several parameters such as mass distribution, tyre friction, speed, and vehicle roll. Unfortunately, the application of such law to control a real motorcycle is difficult and expensive, mainly because several sensors are required. To tackle this complication, we devised a simpler, nearly-optimal control strategy that operates in feed-forward and makes use only of the sensors originally included in the vehicle.

As a result, on gravel and wet roads we can increase the driving force by more than 20% compared to traditional rear-wheel motorcycles. Additional details my be found in: R. Lot and al. «Optimal Traction Strategy for All-Wheel Drive Electric Motorcycles», currently under review on the IEEE Transaction of Vehicular Technology.




Prototype of the electric all-wheel drive motorcycle

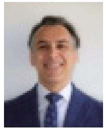
Architecture of the all-wheel drive control system

Research topic:

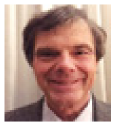
Mechanical systems engineering

DII research group

Flight dynamics and space systems


Roberto Lot
roberto.lot@unipd.it
Phone: +39 049 827 6806


Matteo Massaro
matteo.massaro@unipd.it
Phone: +39 049 8276792


Alberto Doria
alberto.doria@unipd.it
Phone: +39 049 8276803

research.dii.unipd.it/mmsa

Collaborations

Verdiana Del Rosso
Simonetta Boria
University of Camerino

Andrea Andreucci, Alessio Nardini, and Antonio Ranalli
Visionar srl, Osimo

Main research topics

Powered two-wheelers

- Dynamics and control
- Active and passive safety, stability and handling
- Energy efficient, smart, and sustainable mobility
- Race vehicles performance
- Tyre mechanics

Processi e Prodotti Industriali

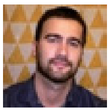
Industrial Products and Processes

DII research group

CAPE-Lab Computer-Aided Process Engineering Laboratory

Massimiliano Barolo
max.barolo@unipd.it
Phone: +39 049 827 5473

Fabrizio Bezzo
fabrizio.bezzo@unipd.it
Phone: +39 049 827 5468



Riccardo De Luca
riccardo.deluca@unipd.it

Investigation carried out in collaboration with Gabriele Bano (GSK, Ware; UK), Emanuele Tomba and Agnese Marcelli (GSK, Siena; IT).

Research co-funded by the University of Padova and GSK (Siena) under the Uni-Impresa 2017 framework.

Keywords: Industry 4.0; digitalization; digital twins; optimization; mathematical models

www.capelab.dii.unipd.it

Main research topics

- Product design and quality control
- Data analysis and process control
- Model development and identification
- Design of energy systems

Speeding up the manufacturing of vaccines: optimization of pharmaceutical lyophilization processes

Freeze-drying (also known as lyophilization) is a process widely used in the biopharmaceutical industry to stabilize and maintain over time temperature-sensitive vaccines, thus increasing their shelf life.

However, freeze-drying is a time-consuming and energy-demanding step in the overall vaccine manufacturing process. Hence, there are strong incentives to reduce its duration (up to 2 days for a single batch), so as to reduce the length of the overall process and consequently the time-to-market of new vaccine products.

One way to achieve this objective is by optimizing the protocols used to operate commercial freeze dryers. This can be done by developing mathematical models representing the true industrial plant, and then using the model instead of the plant to develop optimal operating recipes.

Research at the CAPE-Lab group, in collaboration with GSK (Siena), has focused on two main directions:

- use of advanced statistical techniques to design and carry out highly informative experiments. The resulting protocols allow experimentalists to drastically reduce the time and number of experiments required to calibrate mathematical models of the true plant;
- development of an innovative modeling approach that accounts for intra-lot drying heterogeneity and different equipment load in freeze-drying units. The model has been validated industrially and used to design a protocol that allows minimizing the process duration while guaranteeing all operational and product quality constraints. Results (Figure 1) demonstrate a 20% reduction in process duration.

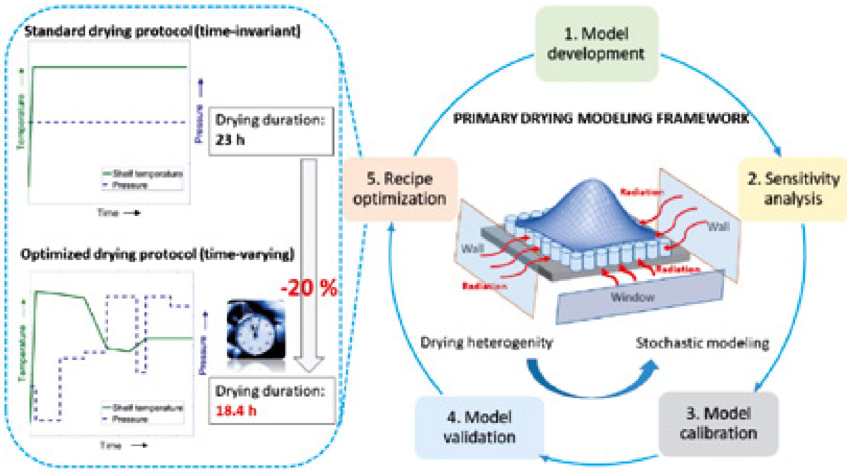


Figure 1. Sketch of the proposed novel modeling approach and consequent reduction in the duratio of the manufacturing process (Bano, De-Luca, Tomba, Marcelli, Bezzo, Barolo (2020). Primary drying optimization in pharmaceutical freeze-drying: a multi-vial stochastic modeling framework. Ind. Eng. Chem. Res., 59, 5056–5071).

Circular Economy in Construction and Demolition Waste: an environmental and economic opportunity

Construction and demolition waste (CDW) includes various materials obtained as result of construction, expansion, restoration, reconstruction, modification, and demolition of buildings or other infrastructures. CDW are made up of various types of products, often very heterogeneous [Figure 1].

The European framework directive on waste commits European countries to achieve 70% reduction in the weight of construction and demolition waste (CDW) through a life-cycle approach and by adoption of reuse, recycling and recovery, avoiding landfill as much as possible. Selective demolition is a realistic alternative to avoid the environmental impacts related to the demolition building: it allows an effective recovery of materials derived from a building demolition, as direct reuse (without any treatment) or recycling (with ad-hoc treatment activities), and it minimizes the amount of waste that must be sent to incineration or landfill (according to their dangerousness) [Figure 2].

However, in Italy selective demolition is still a rare practice today: the most frequently methods of processing waste materials on construction and demolition do not have any waste selection system. The performances of selective demolition (with recovery and recycling) are better than a traditional CDW management (without recovery and recycling), both in terms of avoided environmental impacts and in terms of economic convenience. For example, the results related to an Italian case study, concerning the demolition activities of a family house, show that the selective demolition can avoid several environmental concerns. At the same time, the costs associated to select, recover and recycle materials by CDW permit an economic convenience rather than a non-selective demolition: in selective demolition the most important cost item is that of labor; however, the revenues associated with the recovery of materials far outweigh labor cost [Figure 3].

In fact, selective demolition is a viable solution for sustainable management of construction waste only if it is a constructive specification from the building design. Hence, the next challenge for sustainable construction includes sustainable demolition criteria in building design.

Fig. 1: Types of materials in CDW

Fig. 2: : Circular Economy in Building Sector

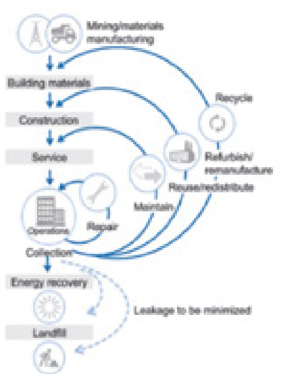
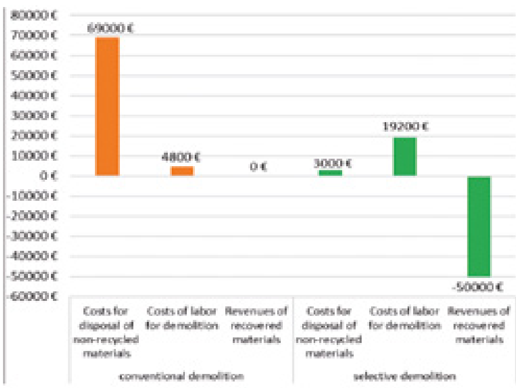


Fig..3: Costs and revenues related conventional and selective demolition



Sicurezza ambientale e industriale

Environmental and industrial safety

DII research group

Environmental and industrial safety

Anna Mazzi
anna.mazzi@unipd.it
Phone: +39 049 8271611

Assisted by
Beatrice Gatto,
PhD student

https://www.dii.unipd.it/en/research/research-topics/environmental-and-industrial-safety

Please see other details in:
Mazzi A., Gatto B., 2020.
Circular economy concept in sustainable building design. Athens Journal of Technology & Engineering 7(1), 31-50. DOI: https://doi.org/10.30958/ajte.X-Y-Z

Main research topics:

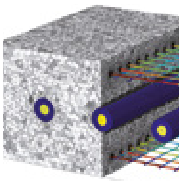
- Environment, recycling and waste management technologies
- Quality and eco-sustainability
- Evaluation of environmental quality and decision-making tools (LCA and risk analysis)

DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

1222·2022 800 ANNI

UNIVERSITÀ DEGLI STUDI DI PADOVA

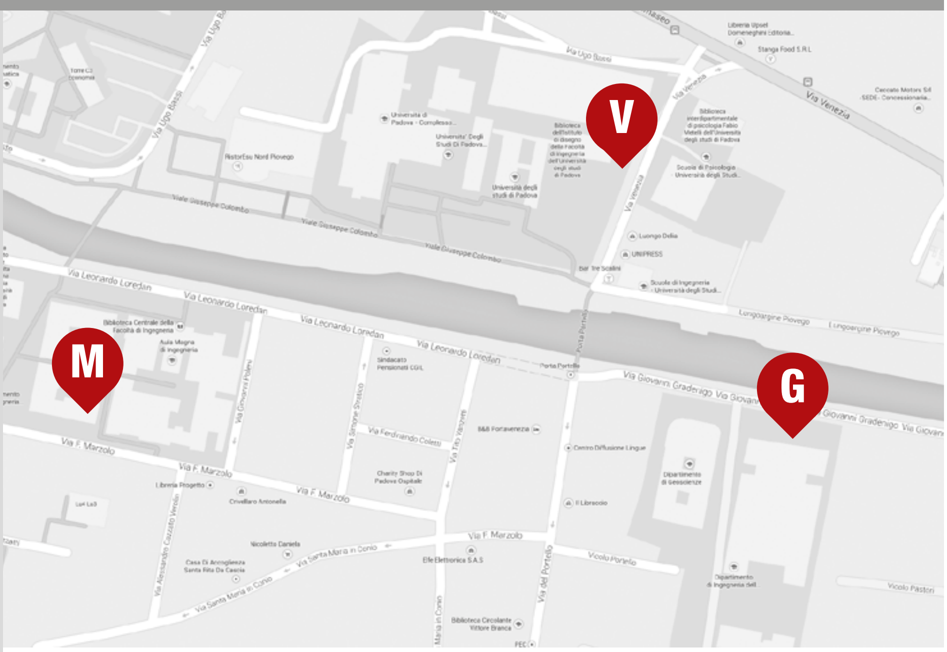
Cover story



L'immagine rappresenta la sezione 3D di una terna di cavi interrati in altissima tensione protetti da una struttura in cemento armato. Sulla sezione di sinistra è rappresenta la mesh per lo studio agli elementi finiti, mentre sulla destra la scala cromatica mette in risalto la distribuzione della densità di corrente indotta all'interno della struttura metallica del cemento armato a seguito di una circolazione di corrente nelle tre fasi. Verificare l'entità di tale corrente indotta è importante per quantificare la massima corrente che può circolare in modo continuativo all'interno dei cavi. Infatti la presenza di correnti nella struttura metallica porta a un surriscaldamento della zona adiacente alle fasi e di conseguenza a una diminuzione della portata della linea in cavo.

Ing. Francesco Sanniti
Nato a Feltre, il 01/04/1994. Si laurea a pieni voti in Ingegneria dell'energia elettrica nel 2019 presso l'Università di Padova ed è ora Dottorando di ricerca presso il dipartimento di Ingegneria Industriale della stessa Università. Svolge la sua attività di ricerca presso il laboratorio di trasmissione dell'energia elettrica sotto la supervisione del professor Roberto Benato. I suoi studi si concentrano prevalentemente sullo sviluppo di metodologie di analisi, controllo e modellizzazione volte a migliorare la stabilità del sistema elettrico. In particolare la ricerca si sta focalizzando sull'implementazione di modelli elettrici per l'analisi delle strategie di riaccensione del sistema elettrico a seguito di blackout estesi.

SEDI



www.dii.unipd.it

Direttore: Stefania Bruschi

Vicedirettore: Piergiorgio Alotto

Segreteria amministrativa:
Paolo Rando

DII
Dipartimento di Ingegneria Industriale, Università degli Studi di Padova

Sede legale e amministrativa
Via Gradenigo, 6/a - 35131 Padova
tel. +39 049 8277500
fax +39 049 8277599
segreteria@dii.unipd.it
www.dii.unipd.it

Via Marzolo, 9 - 35131 Padova

Via Venezia, 1 - 35131 Padova