



Dipartimento di Eccellenza



CROSSLAB
Innovation for industry 4.0

Lab ADDITIVE MANUFACTURING

Simone Genovesi (simone.genovesi@unipi.it)



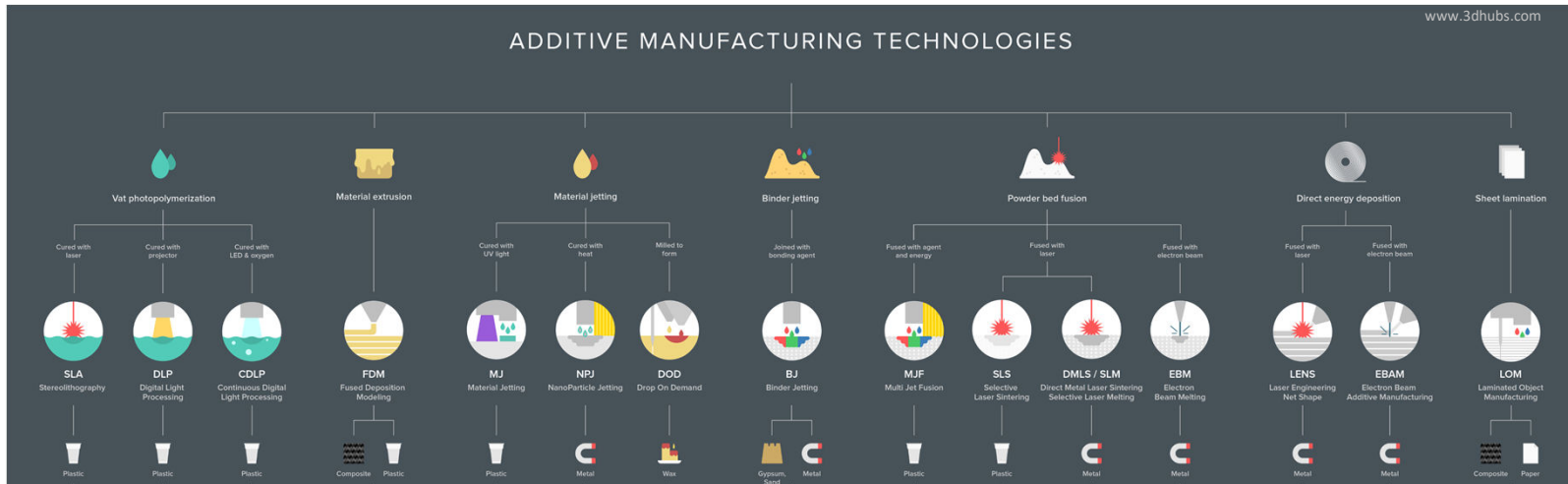
UNIVERSITÀ DI PISA



**REGIONE
TOSCANA**

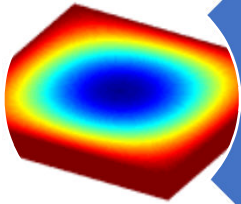


ADDITIVE MANUFACTURING (STAMPA «3D»)



- Non solo 3D
- Esplorare

Advanced materials for innovative products sensors, wearable systems, IoT devices



Modelling

- material properties, sensing principles



Fabrication

- 2D/3D



Characterization

- Mechanical, electrical, electromagnetic

CrossLab Additive Manufacturing

Chi è

- Ricercatori esperti in:
 - additive manufacturing bidimensionale e tridimensionale;
 - caratterizzazione dei materiali, dal punto di vista elettromagnetico e meccanico;
 - modellazione, design e sviluppo di sensori (meccanici, fisici, chimici, bio) che utilizzano materiali multifunzionali.
- Si colloca in quello spazio tra aziende produttori di materiali e service di stampa.



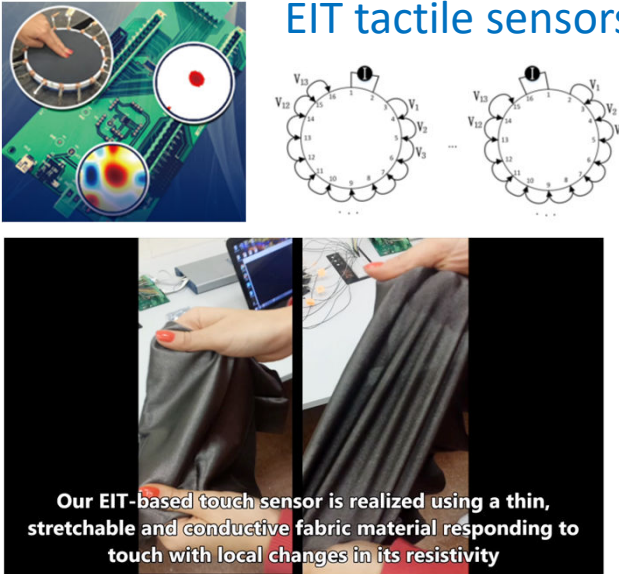
Cosa offre

- Progettazione e realizzazione **2D** e **3D** di dispositivi (sensori, dispositivi wearable, applicazioni IoT) con strumentazione all'avanguardia (anche custom o 'non convenzionale').
- Strumenti per prototipizzazione rapida e misure/caratterizzazione (nuove acquisizioni o già disponibile) e disponibilità di nuovi spazi.
- Supporto a realtà industriali per progetti di innovazione che richiedono un **approccio multidisciplinare** (progetti interni).
- Sviluppo congiunto, prototipazione, riduzione fase idea-to-market, ibridazione con altri processi produttivi.
- Creazione di **sinergie** con chi usa già AM e **contaminazione** di nuove realtà produttive per aumentarne la competitività nazionale ed internazionale.



Progetto LAID

EIT tactile sensors



Our EIT-based touch sensor is realized using a thin, stretchable and conductive fabric material responding to touch with local changes in its resistivity

sensors **MDPI**

Article
A Quantitative Evaluation of Drive Pattern Selection for Optimizing EIT-Based Stretchable Sensors
Stefania Russo ^{1,*}, Samia Nefli-Meziani ¹, Nicola Carbonaro ² and Alessandro Tognetti ^{1,3}

Textile pressure sensor



MATERASSIFICIO MONTALESE SPA



Progetto BMIFOCUS

Human Machine Interaction

Smart brace

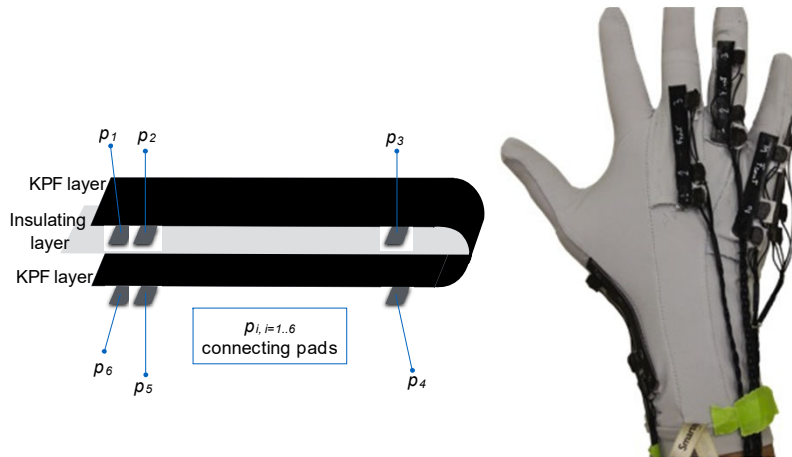
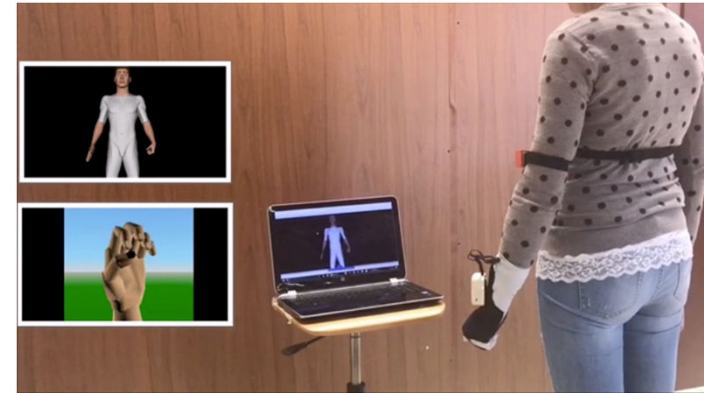
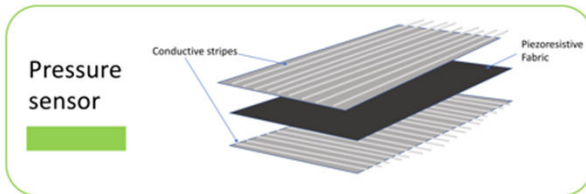
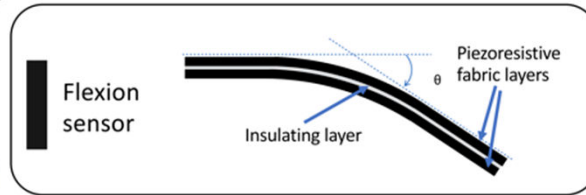
- wearable sensing system applied on the forearm
- detect subject/exoskeleton mechanical interaction (distribution of contact force and pressures)



Mechanical sensing (force, strain, pressure) on flexible/stretchable surfaces (textiles, paper, plastic)



Motion detection & human machine interaction



Journal of NeuroEngineering and Rehabilitation (2016) 13:40
DOI 10.1186/s12954-016-0164-2

Journal of NeuroEngineering and Rehabilitation

RESEARCH Open Access

A bi-articular model for scapular-humeral rhythm reconstruction through data from wearable sensors

Federico Lorussi^{1*}, Nicola Carbonaro², Danilo De Rossi^{1,2} and Alessandro Tognetti^{1,2}

Tognetti et al. Journal of NeuroEngineering and Rehabilitation 2014, 11:15
http://www.jneuroengrehab.com/content/11/1/15

JOURNAL OF NEUROENGINEERING AND REHABILITATION

RESEARCH Open Access

New generation of wearable goniometers for motion capture systems

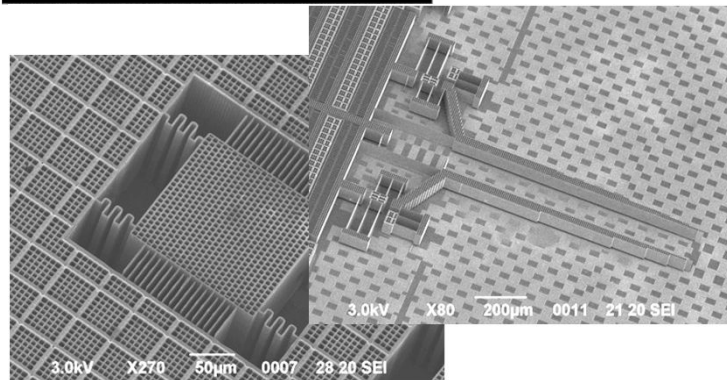
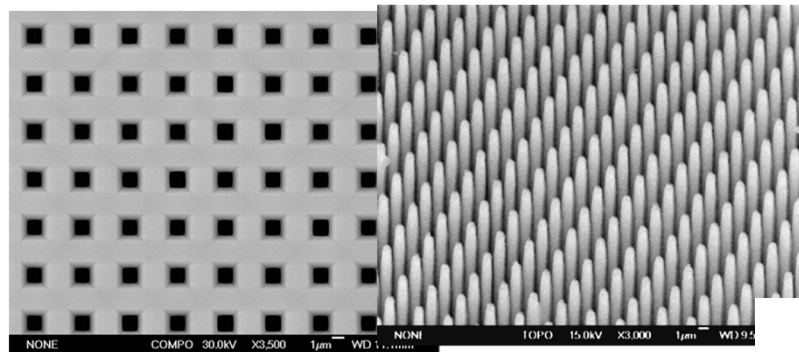
Alessandro Tognetti^{1,2*}, Federico Lorussi¹, Gabriele Dalle Mura¹, Nicola Carbonaro¹, Maria Pacell¹, Rita Paradiso¹ and Danilo De Rossi^{1,2}

1788 IEEE JOURNAL OF BIOMEDICAL AND HEALTH INFORMATICS, VOL. 18, NO. 6, NOVEMBER 2014

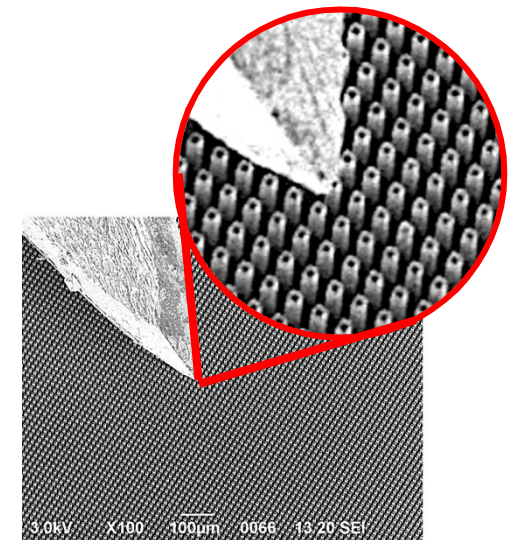
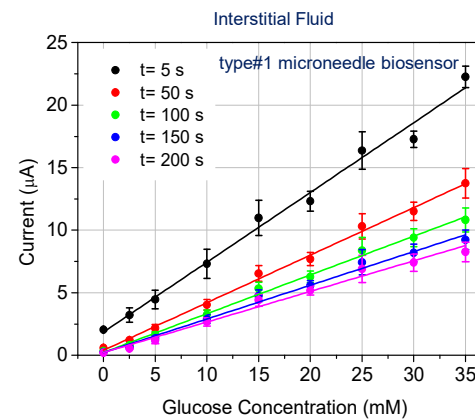
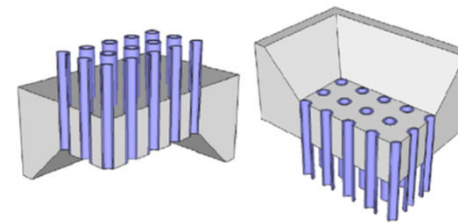
Exploiting Wearable Goniometer Technology for Motion Sensing Gloves

Nicola Carbonaro, Gabriele Dalle Mura, Federico Lorussi, Rita Paradiso, Danilo De Rossi, and Alessandro Tognetti

Micro and Nanostructuring for microelectronics/nanophotonics (bio)sensing and (nano)medicine



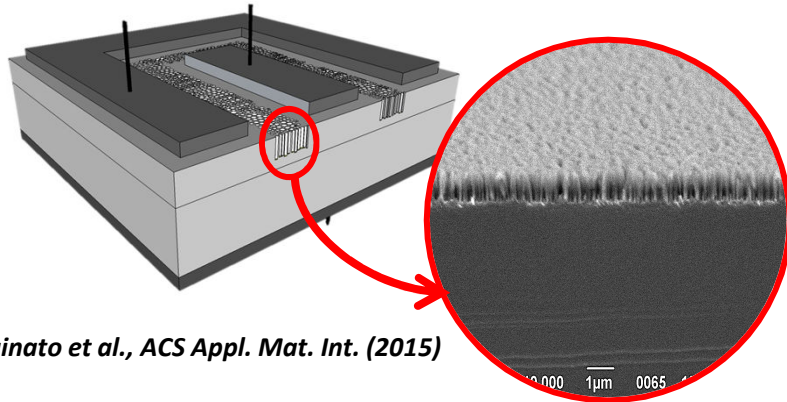
Micro and nanostructuring through direct etching



C. Cozzi et al. Advanc. Funct. Mater. (2017)
M. Bassu et al. Advanc. Funct. Mater. (2012)

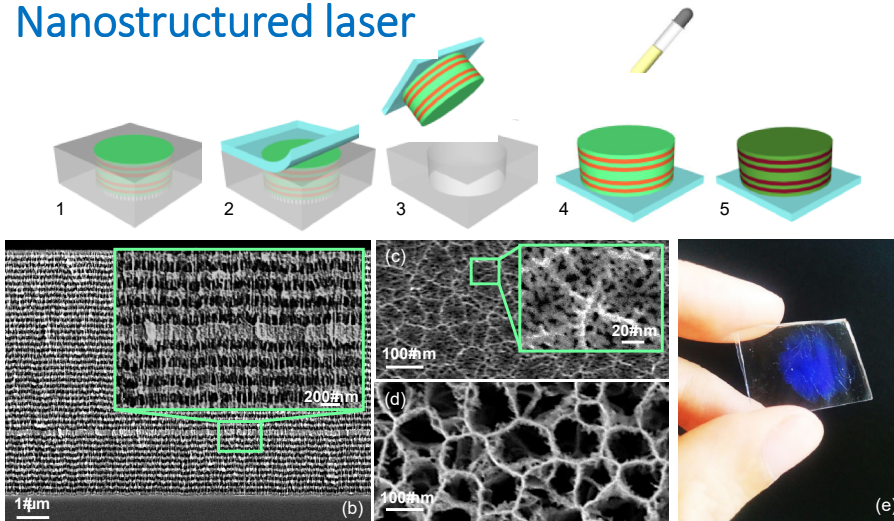
Micro and nanoneedles for transdermal biosensing
L. M. Strambini et al., Biosensors Bioelectronics (2015)

Nanostructured Chemi-transistor sensors



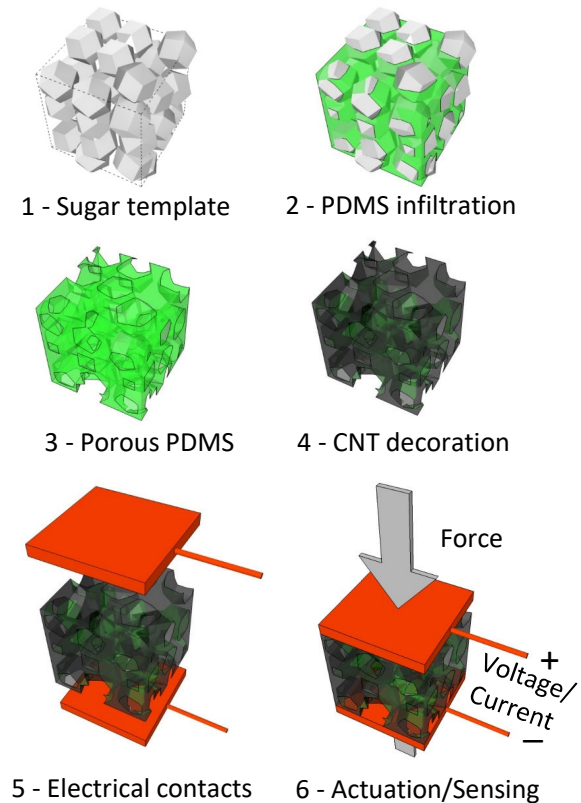
M. Sainato et al., ACS Appl. Mat. Int. (2015)

Nanostructured laser

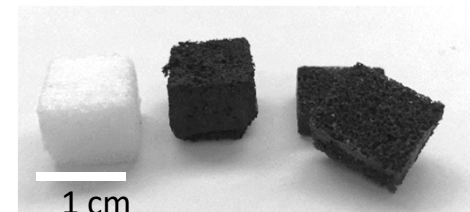


V. Robbiano et al., ACS Nano (2018)

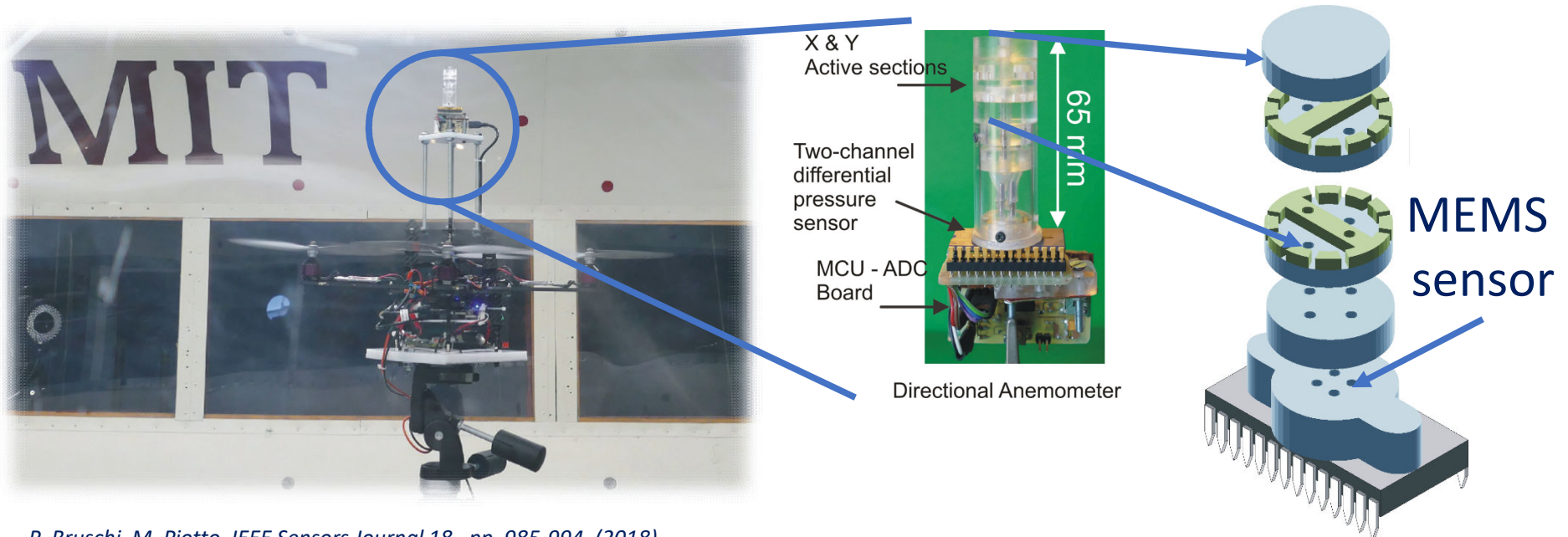
Micro and nanostructuring through replica molding



R. Iglio et al., ACS Applied Materials and Interfaces (2018)



Very sensitive, ultra compact 2D air-flow sensors



P. Bruschi, M. Piotto, IEEE Sensors Journal 18, pp. 985-994, (2018)

Applications:

-) Robotic gas tracking
-) UAV wind measurement

Additive manufacturing:

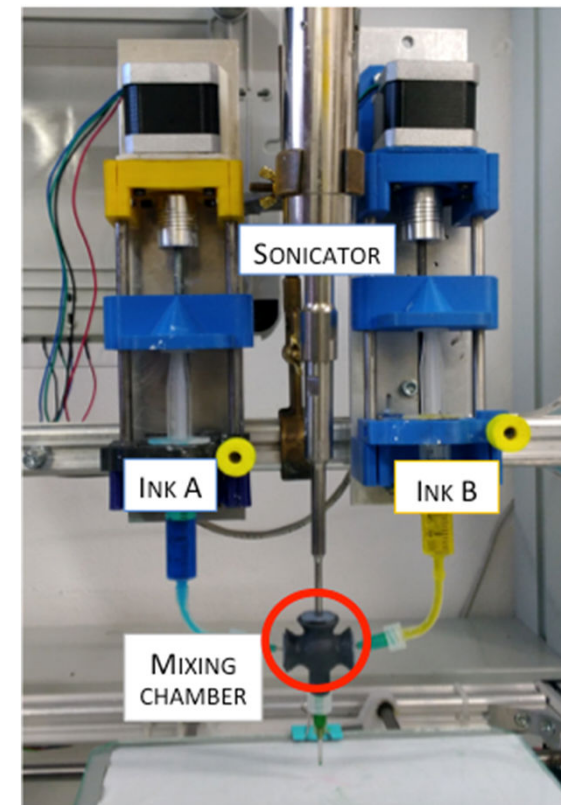
-) Fast prototyping
-) Extreme miniaturization

Ongoing research: additive manufacturing with unconventional materials

- Fabrication of complex shapes using multicomponent pastes, conductive (bio-)inks

- **Case studies:**

- mixing chamber for 3D printing of non-stable viscous multicomponent inks prepared «on the fly» (e.g. bicomponent silicones, doped materials)



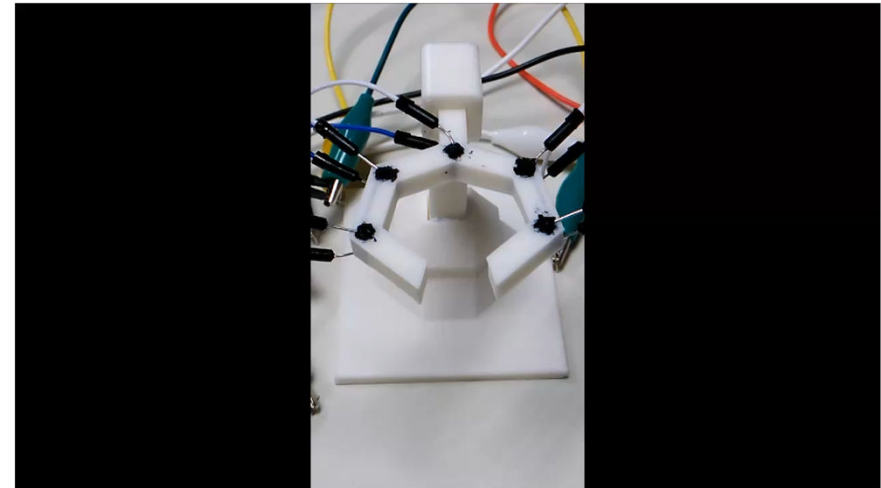
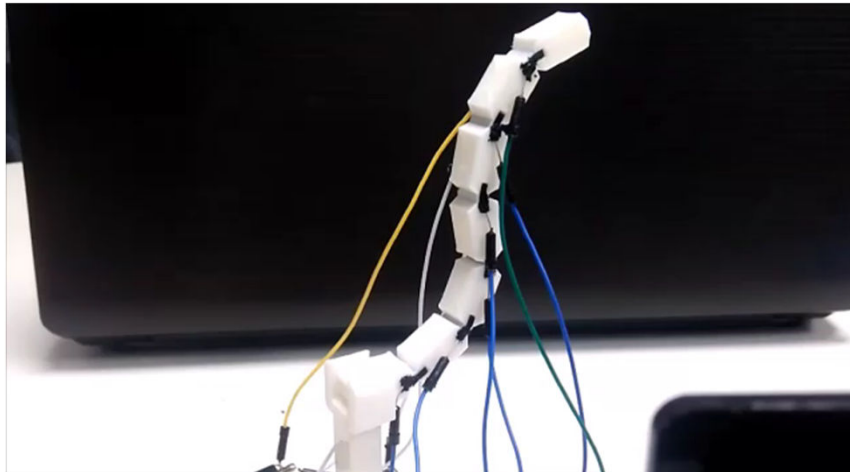
Ongoing research: additive manufacturing with unconventional materials

- Fabrication of complex shapes using multicomponent pastes, conductive (bio-)inks
- Design of custom-made tools and printheads
- **Case studies:**
 - 3D printing of conductive inks on soft, non-flat (biological) substrates

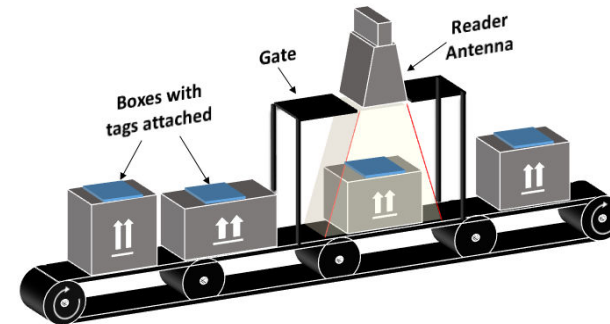
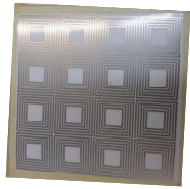


Ongoing research: additive manufacturing with unconventional materials

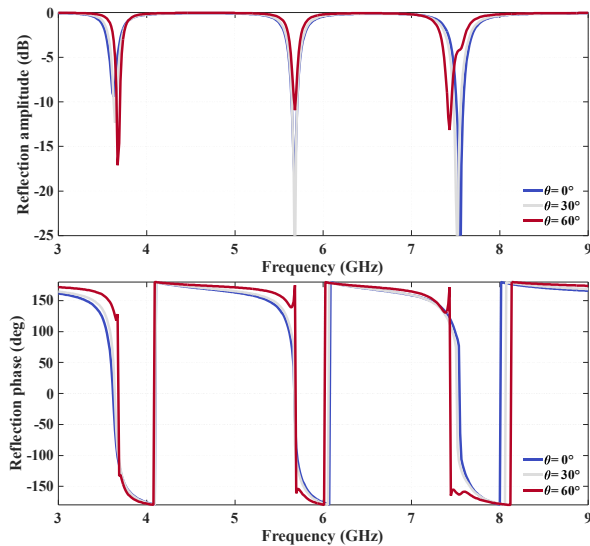
- Fabrication of complex shapes using multicomponent pastes, conductive (bio-)inks
- Design of custom-made tools and printheads
- 3D printing of actuators and 4D printing



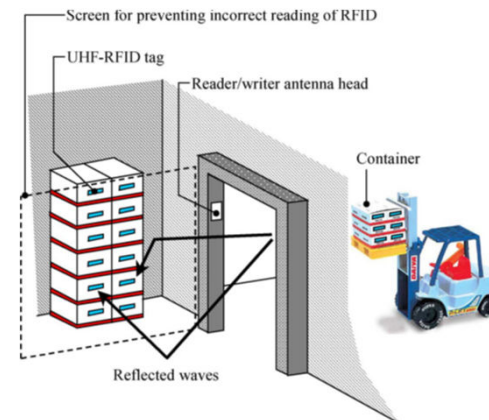
Chipless RFID Tags and shielding for logistics



Amplitude (absorption)/phase encoding



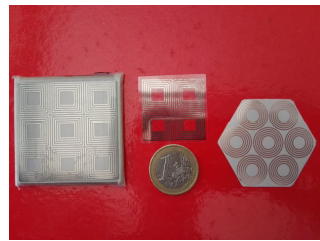
F. Costa et al., "Robust Reading Approach for Moving Chipless RFID Tags by Using ISAR Processing," IEEE Transactions on Microwave Theory and Techniques, vol. 66, no. 5, pp. 2442–2451, 2018.



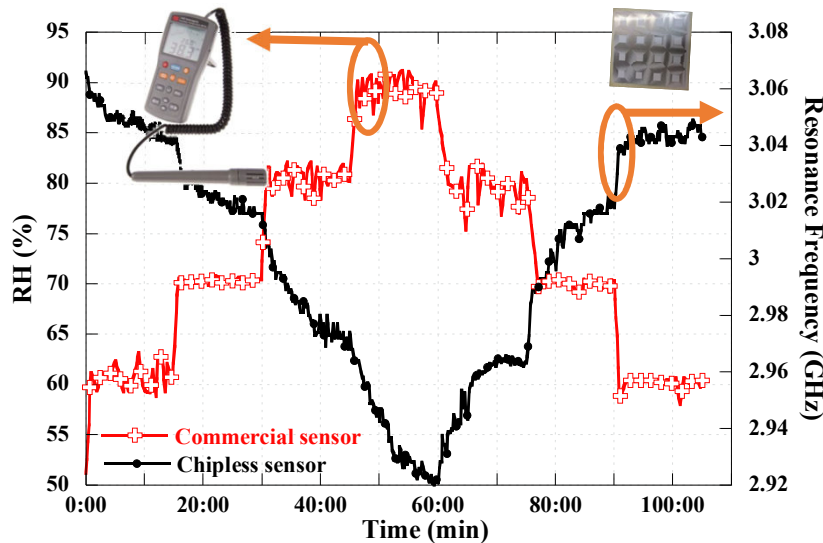
- F. Costa, S. Genovesi, A. Monorchio, "A Chipless RFID based on Multi-Resonant High-Impedance Surfaces" IEEE Transactions on Microwave Theory and Techniques, vol. 61, no. 1, pp. 146-153, 2013;
- F. Costa, S. Genovesi, A. Monorchio, "Dispositivo per l'identificazione di oggetti a radio frequenza", Italian Patent (PI2013A000047).

Chipless RFID Sensors

Sensors for next generation pervasive interconnected systems with environmental-friendly substrates such as paper and low-cost printing process.



Platinum-Aziende e Protagonisti (Sole 24 Ore) Ricerca & Innovazione, Novembre 2016



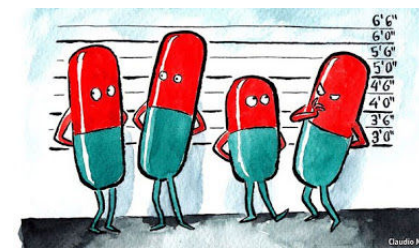
Project funded by the European Union under the H2020 Programme, Call MSCA-RISE-2014 'Marie Skłodowska-Curie, Research and Innovation Staff Exchange (RISE)', GA n. 645771

Chipless RFID for anti-counterfeiting

Same technology can be employed for additional security at physical level in documentation, for anticounterfeiting (drugs, fashion), monitoring goods (invisible tags), innovative devices.

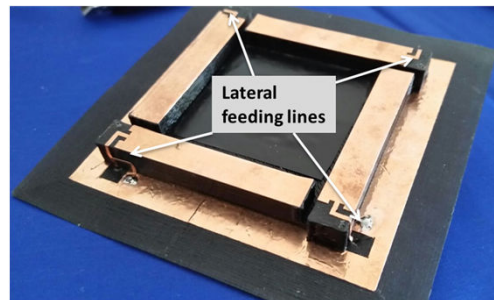
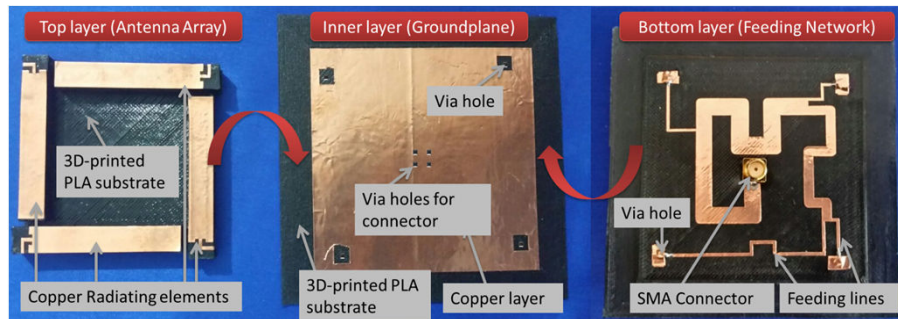
Invisible, compact, RF fingerprint can provide increased level of data and good protection.

**REAL LADIES
DON'T LIKE FAKE!**



Additive Manufacturing for Antenna Design

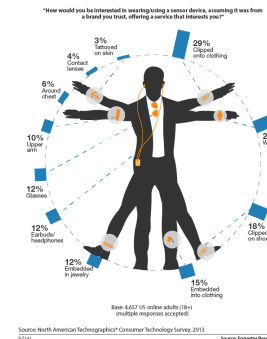
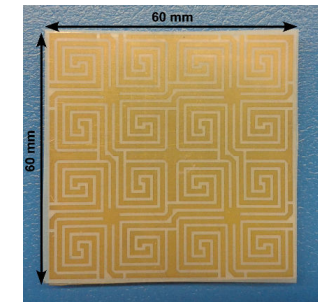
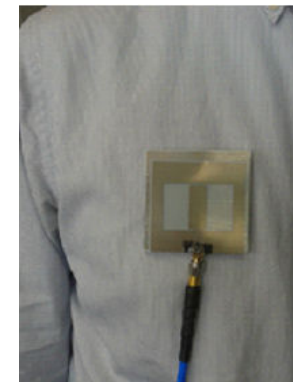
Antenna for UHF RFID portable readers (865-868 MHz).



R. Colella, A. Michel, and L. Catarinucci, "Compact 3D-Printed Circularly Polarized Antenna for Handheld UHF RFID Readers", *IEEE AWPL*

andrea.michel@unipi.it

Compact devices for Wearable
Wireless Body Network



S. Genovesi, F. Costa, F. Fanciulli, and A. Monorchio, "Wearable Inkjet-Printed Wideband Antenna by using Miniaturized AMC for Sub-GHz Applications," *IEEE AWPL*, 2016.

simone.genovesi@unipi.it



CrossLab e formazione

Laurea
magistrale

- Percorsi eccellenza su tematiche I4.0
- Stage di tesi 4.0 presso aziende

Dottorato

- Attivazione di borse di Dottorato di Ricerca «Industriali», Assegni di Ricerca e RTD

Master

- Summer School Enabling Technologies for IoT
- Nuovi master (sponsorizzazione)

Corsi brevi su
tematiche I4.0

- Corsi formazione del personale (esigenze specifiche, intensivi, fine settimana)

Ascoltare ...

TT|TECNOSISTEMI
Immagina la Tecnologia Umana



COLOROBIA

**MAESTRELLI
LUCIANO**
engineering

SIGMAINGEGNERIA

LINARI
NanoTech

e-SPres3D

CADmanager
3D ADDITIVE MANUFACTURING SOLUTIONS
member of THE **3D** GROUP

