



A new COLLOIDAL cybernetic system tOWaRDs 2030

Foreword by the coordinator

Three years and a half ago, project COgITOR started. At that time, it was literally impossible to imagine the results that we have achieved so far. All such outstanding research outputs in the field of soft robotics and unconventional computing were communicated between the 31st of October and 1st of November, in Nizza Monferrato (Asti, Italy), during a dedicated workshop we have organized, the COgITOR Readings. Results related to liquid computing devices, amorphous memories, neuromorphic systems, material science, energy harvesting from thermal gradients, and self-healing skins were showcased.

Scientists from all around the world have been involved, including the United States of America, Australia, European countries, and of course the beneficiaries of the project: Istituto Italiano di Tecnologia in Genova – Italy, the University of the West of England in Bristol – U.K., Empa in Dübendorf and EPFL in Lausanne – Switzerland, CiaoTech (Italy) and PlasmaChem (Germany). Some stakeholder representatives were also present, sharing the point of view of their important companies and research institutes that could benefit from the exploitation of our consortium results.

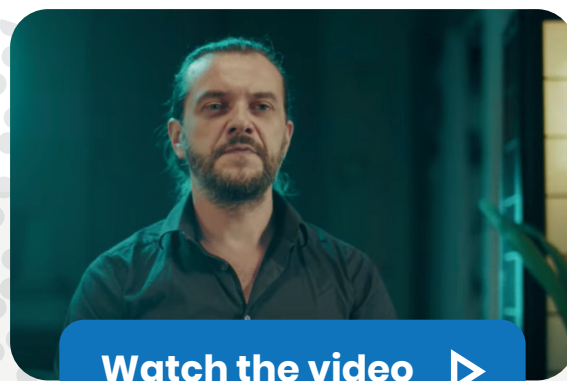
As we believe in open science practices, we think that it's mandatory to share such important information beyond the scientific community, and reach a broader audience. Therefore, all the presentations have been made freely available to anybody interested in the form of PodCast.

CogITOR Readings workshop in Asti, Italy



Aim of the COgITOR Readings workshop was that of creating a brainstorming-like atmosphere, so to share ideas among scientists and give shape to the future of colloidal-enabled technologies, including working around new concepts for future proposals.

Featuring 30 people in presence and up to 50 in remote connection, the workshop represented an extremely rich and dense event. Hosted by the wonderful historical winery Bersano, in Nizza Monferrato (Asti, Italy), the workshop conjugated a vibrant UNESCO world heritage environment with a special collection of minds.



The podcast

Being compliant with open science practices, we wanted to reach a broader audience making use of modern instruments, such as PodCasts. All the presentations delivered at the COgiTOR Readings were processed by the DocAbout association and made freely available on the Spreaker platform. Listen to our inspiring talks!

So far, 10 episodes have already been published.

Episode #10: Prof. Garoli in his talk presents research activity on iontronic devices, an extremely promising field that will enable processing information with ionic channels, instead of electronic ones. By leveraging on the abundance of ions he envisages multi-binary parallel logics to enable future technology conceived for neuromorphic computing and biosensing.

Episode #9: Dr. Braun discusses the exciting advancements performed in the field of soft matter, resulting in multifunctional artificial skins including sensing and also actuation capabilities. Biomimetic self-healing compositions are explored, enabling future biomimetic soft robots.

Episode #8: Dr. Tarabella discusses several examples of recent research performed with organic semiconductors and devices, developed with novel processing technologies and materials, featuring unprecedented sensing capabilities. Findings enable brand new devices based on soft matter of great availability and sustainability.

Episode #7: Dr. Fortulan presents amazing findings about the advanced electronic properties of both synthetic and natural colloids, in particular memfractance and reservoir computing (RC) tasks. He shows that RC is exceptionally executed by modified egg white proteins, providing an abundant source substrate, and featuring excellent figures of merit, compared with conventional artificial neural networks. The future technology enabled is computing with natural colloids.

Episode #6: Prof. Chiolerio discusses how the architecture design of a holonomic cybernetic system has changed and evolved to take into account recent advancements in the pioneering research on colloidal substrates. Liquid state machines, neuromorphic systems, learning and plasticity, multi-particle phase correlation are addressed. Findings enable an upcoming technology based on holonomic liquid devices for massively parallel computation.

Episode #5: Dr. Antipov discusses the challenges to be faced during the synthesis of commercial colloids, including routes to fabricate high stability, high purity bismuth ferrite nanoparticles featuring the desired oxidation state and crystalline phase. This exciting talk on nanomaterials synthesis for high tech applications brings us directly into the future.

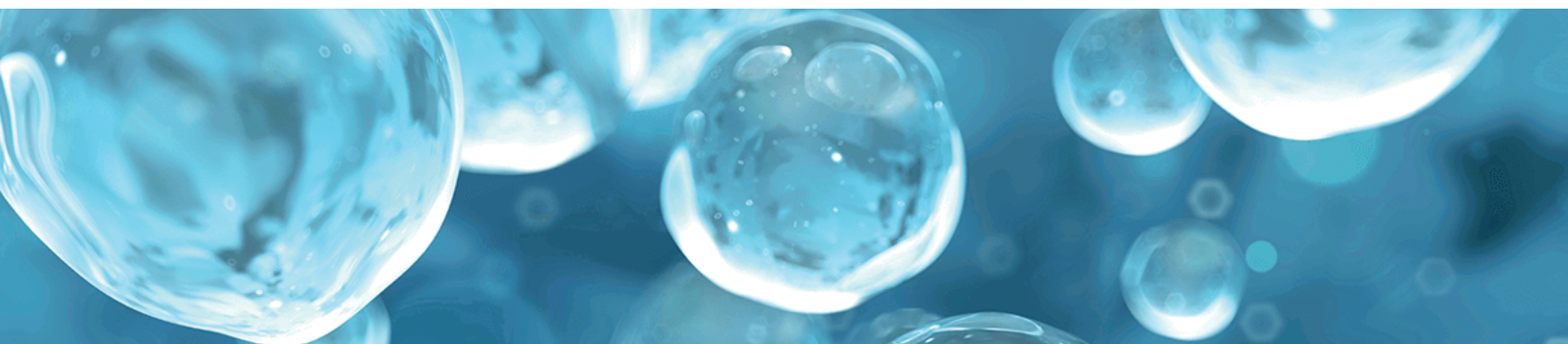
Episode #4: Dr. Crepaldi proposes an innovative path towards establishing a digital twin of the colloid electrodynamics based on an artificial neural network. The consequences of such visionary idea is that artificial intelligence could be trained with the raw experimental measurements collected in the last years to create a comprehensive model, that later could be made free to access, making available to the broader community a precious resource.

Episode #3: Dr. Nunes dos Santos introduces us to the marvelous world of self-healing polymers, in other words plastic components that can restore their integrity after being damaged by scratches or cuts, by exploiting their labile chemical bonds that can be easily activated raising their temperature by some degrees. Such materials hold an enormous potential for many future applications, including home devices.

Episode #2: Dr. Nikolaidou presents living and hybrid unconventional materials, combining sustainable features with active properties, including sensing capabilities. Her exciting research is based on functionalized kombucha hydrogels, that involve living yeasts and bacteria communities populating a soft cellulose network. Future applications encompass smart living buildings and wearable devices.

Episode #1: Dr. Raeisi Kheirabadi introduces us to the most recent exciting discoveries about the fault tolerance of colloid-based computing devices, arising from the amorphous characteristics of the colloidal mixture. These findings highlight the viability of colloid-based computing for future unconventional computing technologies.

More will follow, stay tuned!



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