AI

Chair: Mirko Cestari

UNIFE - Fabrizio Riguzzi

What is AI?

Artificial Intelligence has been making the journal headlines in the last few years. This is due to the strong results that it achieved in the fields of computer vision, natural language processing and understanding and games. However, AI is much more: in its more than half-century life it has developed a wide variety of techniques for solving problems that are believed to require intelligence and that go beyond the one mentioned above. The talk will survey the current state of AI, discuss why it has become so important and present directions for its future evolution.

AXYON – Giacomo Barigazzi

AI and Deep Learning in Finance: applications, limits, impact and use-cases.

Artificial intelligence (AI) is disrupting many industries, and finance is expected to benefit the most out of including AI systems in the next 2 years. Analysts estimate that AI will save the banking industry more than $1 trillion by 2030. However, the process of implementing completely automated AI-based rules and algorithms is still at the very beginning. Giacomo Barigazzi, co-founder of Axyon - a company specialized in using AI and DL to build highly accurate predictive models for the financial sector - will provide an overview of the current market scenario and future expectations, and present examples of applications already used by large banks.

Injenia - Luca Paganelli

Real deep learning applications to create effective digital twins

The rapid evolution on deep learning techniques and the improvements on both hardware and software technologies enable today unique perception capabilities to create effective digital twin solutions. We will show 3 cases that combine CNNs, RNNs and FCNs for vision, text and language understanding, time-series analysis to create proficient operation support and decision support systems.

UNIBO - Andrea Borghesi

AI in HPC: Machine Learning and Optimization for Better Decisions in Data Centers and Industry

Artificial Intelligence (AI) has been rapidly developing in the last few years to solve a wide array of problems, from image recognition and speech translation to predictive maintenance or resource management in large-scale data centers. The common idea underlying these wide-ranging approaches is to improve the performance of automated systems and processes by infusing them with human intelligence and reasoning capabilities, with the general goal of taking better decisions.Two of the main enabling factors of AI are the availability of large amount of data (Big Data) and computing power, two features that can be provided by data centers and High Performance Computing systems. In this talk we discuss the potential of AI applied to HPC system, especially in terms of automated & predictive maintenance and system management optimization. In the context of industries, factories and data centers, AI- guided approaches can lead to great improve in the system management and process automation. In particular, Machine Learning and Optimization are two AI areas with a rich history of success. For instance, data analytics and AI models can be merged to obtain accurate fault and anomaly detection mechanism, that can automatically identifying system components that need to be repaired or changed. The following step is not just to be reactive, but rather to forecast faults and apply preventive techniques (predictive maintenance), in order to lower downtime andquality if service loss. In large data set and supercomputer, AI-basedapproaches can also be used to improve the overall management of the systems,from optimizing the scheduling policies to decreasing the power and energyconsumption of the facility.

BIORETICS - Matteo Roffilli

Integrated machine & deep learning techniques for the acceleration of image interpretation processes in industry and medicine

In a society planned by machines, man still represents the reference point for decision-making processes based on images, especially when they involve important decisions. Interpreting a complex image requires capacities that are still outside the scope of current algorithms, although in sectors with low added value it is already possible to delegate. In these times of media boiling on Artificial Intelligence, we will present some last generation techniques that, coupled with the human interpreter, make the search and classification processes of objects in large volumes of 2D and 3D data much more effective and drastically more efficient. Fil rouge of the presentation will be real use cases in high added valued sectors such as industrial automation and life science.

Nokia - Chiara Rampini

At Nokia Global Services we leverage extreme automation, analytics and artificial intelligence to provide the full lifecycle of services that our customers need to ensure their networks, create business value for their subscribers, employees and constituents. In particular two uses cases will be presented:

an AI solution aimed at assiting sales force in writing RFI, RFP and RFQ and a cognitive based solution for the automated clearing of the alarms coming from the network.

Big Data and Analytics

Chair: Giuseppe Fiameni

Leithà(Unipol Group) - Francesco Garibaldi Rolando Lerro

How to build a serverless data pipeline for Insurance Telematics and sleep at nights

How hard is it to scale up to ingest hundreds of millions messages per day? Can you get real-time insights from big-data? During this session we will learn how to build a data pipeline with a completely serverless architecture. We will discuss advantages in terms of scalability and reliability.

PORINI - Mario Gennari

Collect, Manage and Analyze data in a scalable way using Microsoft Azure AI & Cloud capabilitiesin Manufacturing

IoT & Big Data, proactive and predictive analytics, from theory to practice we'll describe how our customers are facing the digital transformation journey using the Microsoft platform solution and Porini's competence and experience.

DATALOGIC - Alessandro Chiarini

Datalogic: vision and challenges for Industry 4.0

Cyber Physical Systems -CPS- are a key concept in Industry 4.0. They involve a sophisticated combination of sensors that capture data for manufacturers in order to identify and manage traceability of spare parts and intermediate goods alongside the supply chain, the manufacturing process, the outbound logistics and the aftersale. Machine Vision plays a key role in any automation system of Industry 4.0. As key enabling technologies such as cloud computing, big data processing and machine learning progress, the increasingly higher volume of data accessible through vision deviced will be used to detect and mark defective products understand anomalies and enable more effective and efficient maintenance interventions.

Fintech SandLaboratory, University of Pavia - Alessandro Spelta

Network based credit risk models

Financial technologies, that disintermediate banks through peer-to-peer smartphone based platforms, are becoming an important tool not only in payments but also in credit lending. While in clasical bank lending credit risk is taken by the bank itself, in peer-to-peer lending platforms the risk is fully borne by the lender. This calls for adequate controls on credit risk mesurements, to protect investors and preserve financial stability. In the paper we show that credit risk accuracy could be improved leveraging the information embedded into similarity networks derived from borrowers balance-sheet features. Relevant patterns of similarities describing borrowers' importance and community structures are extracted from the networks and employed as additional explanatory variables for improving the performance of different classes of credit scoring models. Our empirical findings suggest that the approach is effective for discriminating between defaulted and sound institutions. Hence, the proposed methodology can constitute a new instrument for both risk regulation and supervision and technological compliance.

DataRiver – Marco Pacchioni

MyHealth IoMT Platform: IoT and Big Data in Healthcare

MyHeath is a Internet of Medical Things (IoMT) Web and Mobile platform designed to provide clinical monitoring of patients, with the aim of improving the health and quality of life of people. MyHealth allows automatic collection of data related to the patient's physiological parameters and physical activities through both medical and wearable devices. Medical staff through MyHealth Web platform could manage patient questionnaires collected through MyHealth App. MyHealth Platform allows to contact patients and offer them support at the right times through an advanced analysis of the data collected.

Engineering - Monica Franceschini

Dive Analytics: a data-driven solution for performing predictive maintenance through Big Data technologies

AI and Big Data technologies can play an effective role to help the manufacturing industry increasing efficiency in work methodologies and augmenting the business productivity of the plants. Advanced analytics are involved to monitor the health status of machinery, anticipating possible breakdowns or the need for extraordinary maintenance before an unexpected failure. Dive Analytics adds real-time data gathering, machine learning, and deep learning plus expressive data visualization tools to all of the above.

MOXOFF - Matteo Longoni

Extract your value from your data

The need to collect data is well known in industry, especially in the Industry 4.0 framework, as they are a precious raw source of information. But the growing question is which is, and how can I find the right set of instruments to look into and exploit this source of value at maximum? That means according to my specific business need and avoiding wasting resources. Success stories in industry demonstrate the capabilities of a customized mathematical approach.

HPC & Simulation

Chair: Simone Bna

Intel - Andrea Luiselli

Intel strategy and innovation to support HPC and AI at scale

How new Intel strategy can respond to heterogeneous HPC application needs in order to accelerate and optimize production requirements. Let's have an overview of Intel strategy, on manufacturing, architecture and software to accelerate application and datacenter needs to satisfy end user requirements.

CHIESI - Roberto Gaspari

Computer simulations for product and process design in pharmaceutical R&D

Pharmaceutical development is complex and often progresses by trial and error procedures. Here we provide an overview on how computational modeling can be used to rationalize processes from a pharmaceutical R&D perspective and in areas such as the mixing of dry powders and their interactions with medical devices.

ANSYS - Fabio Bonsanto

High Performance Computing: simulate larger designs with more parameters in far less time.

High-performance computing (HPC) is an enormous part of the present and future of engineering simulation. HPC allows best-in-class companies to gain high-fidelity insight into product behaviour, insight that cannot be obtained without the detailed simulation models – including more geometric detail, larger systems, and more complex physics. When applied to design exploration that enables a product development organization to explore how a design will behave across a range of real-world operating conditions, HPC can lead to robust product performance, and reduced warranty and maintenance costs.

DOMPE' - Andrea Beccari

Exscalate EU!: EXaSCale smArt pLatform Against paThogEns

The High Performance Computing Exa-Scale-Ready, Structure-Based Drug Design System, or rather a calculation system capable of accelerating the search for new drugs, which is particularly useful in epidemics caused by pathogens.

M3 - Carlo Janna

HPC linear solvers for challenging real world problems

The demand for accurate and reliable numerical simulations of complex phenomena is increasing exponentially due to industry digitalisation in every field of application. Despite of the differences, however, there is always the need to solve large size linear systems arising from discretised partial differential equations. In real world simulations, solving linear systems may take up to more than 90% of the total computational time. The focus of this talk is presenting the most recent methodologies available for solving sparse linear algebra problems on massively parallel platforms thus greatly reducing simulation cost and time to market.

eXactLab - Giuseppe Piero Brandino

Enabling HPC/Cloud Services from the Research Environment to the Industrial Context

In this short presentation we will discuss the many challenges and some success stories in our restless effort, as an SME, to promote HPC/Cloud services toward the industrial market. Our company, founded as a research spin-off, is now evolving and is competing in the growing HPC industrial market with a blend of technical/scientific competences associated with appropriate customer care. We will report on this evolution discussing and presenting two success stories from the company portfolio in our target markets: public sector and industry. The first, and more traditional one is the on-going collaboration with ARAP-FVG on the full stack HPC services ranging from HPC sys-adm, forecast workflow and software stack optimisation up to the design of data services on their platform complemented by business continuity service on our own HPC infrastructure. The second case study we will talk about is the on-going collaboration with a steel production market leader where HPC skills are used to optimize time constraint software application on a real industrial production line: we will discuss our successful HPC approach to solve the problem on real production cases and how this can increase production speed and quality.

Digital Twins

Chair: Ivan Spisso

ESI - Valerio Galli

Hybrid Twins: adapting to multi-uncertain evolving environments

In the previous industrial revolution, virtual twins (emulating a physical system) were major protagonists. However, usually numerical models (virtual twins) are static, that is, they are used in the design of complex systems and their components, but they are not expected to accommodate or assimilate data. The reason is that the characteristic time of standard simulation strategies is not compatible with the real-time constraints mandatory for control purposes. Model Order Reduction techniques opened new possibilities for more efficient simulations. The next generation of twins, the so-called digital twins, allowed for assimilating data collected from sensors with the main aim of identifying parameters involved in the model as well as their time evolution in real time, anticipating actions from their predictive capabilities. Thus, simulation-based control was envisaged and successfully accomplished in many applications. Despite an initial euphoric and jubilant period, unexpected difficulties appeared immediately. Namely, in practice significant deviations between the predicted and observed responses were noticed, limiting or abandoning their use in many applications. In that framework of multi-uncertainty evolving environments, Hybrid Twins we proposed, consisting of three main ingredients: (i) a simulation core able to solve complex mathematical problems representing physical models under real-time constraints; (ii) advanced strategies able to proceed with data-assimilation, data-curation, data-driven modelling and finally data-fusion when using compatible descriptions for the physical and data-based models; and (iii) a mechanism to adapt the model online to evolving environments (control).

ANSYS - Fabio Bonsanto

The promise of Digital Twins: how simulation-based digital twins improve product and process performance.

A digital twin is a real-time, virtual copy of an actual operating machine that provides insight into individual product performance and maintenance. Sensors on the machine relay data — temperature, pressure, flow rate, voltage, loading, etc. — to the digital twin, and the twin evolves in step with the machines working environment. The digital twin can predict conditions long before they happen, so you can take corrective actions during scheduled downtime, rather than making an untimely shutdown. You can also use the collected data to improve the design of next-generation products.

RBF MORPH - Marco Evangelos Biancolini

RBF mesh morphing and reduced order models (ROM) squeeze high fidelity CAE simulations into real time digital twins

High fidelity CAE models are a key enabler to make the digital twin technology available. The behaviour of a physical asset can be in fact be accurately reproduced by simulation of the multi-physics governing its evolution. The numerical complexity can be faced by HPC and many possible states of a system can be screened in advance. Reduced order models (ROM) allow to compress the predicted physics into lightweight and portable models capable to operate in real time without the need of accessing the HPC infrastructure and CAE solvers. Radial Basis Functions (RBF) mesh morphing together with ROM allows to get interactive CAE models that are parametric with respect to the physical shape of the components. Practical applications involving ANSYS ROM technology and RBF Morph mesh morphing tools will be shown to demonstrate the concept.

UNIBO - Andrea Borghesi

A self-monitoring supercomputer: coupling fine-grained monitoring, Big Data, and AI to obtain a digital twin for a HPC system

Supercomputing systems are a key ingredient of the Industry 4.0/Big data revolution but are also a complex industrial platform on their own. In this talk we discuss an approach for building Virtual Twins of a supercomputing system. The first step to obtain a digital twin is to implement a monitoring framework with a high level of detail and granularity, that can be used to characterize the target system. The data collection infrastructure has to be scalable and capable of handling large amount of information, thus big data oriented. With the wealth of collected data it is possible to create a virtual model that describes and behaves similarly to its physical counterpart and that can be used for automated processes and predictive, maintenance. For examples, if we infuse reasoning capability (via Artificial Intelligence techniques such as Machine Learning) in the digital twin, we can automatically detect faults or anomalous conditions disrupting the normal behaviour of the supercomputer. Moreover, AI approaches can be also used for improving the general system management, i.e. improving the scheduling and resource allocation policies on the basis of predicted evolution of the system. In the context of HPC, the monitoring infrastructure and the added AI can be hosted on the supercomputer itself, thus creating a self-monitoring and -adapting system.

SAIPEM - Enrico Girello, SAIPEM s.p.a., Nicolò Spiezia, M3E s.r.l.

Towards a Riser Digital Twin

Digitalization is rapidly becoming a reality for a wide spectrum of industries, including the off-shore one. This project focuses on risers, a special type of conduit to transfer materials from the seafloor to production/drilling facilities atop the water's surface. Assessing the Remaining Useful Life (RUL) of risers is crucial, considering also the severe environmental conditions these structures may be subjected to. State of the art simulation software together with Machine Learning techniques are used to develop a Digital Twin model of risers to assess its RUL, thanks to available real-time data.

Optimad - Haysam Telib

How to combine data and modellization in the design phase? An overview on different DigitalTwins approaches.

Within this talk several approaches on how to combine experimental data and numerical simulation in the product definition phase will be presented. The relationship with technology trends in modellization, simulation and manufacturing will be discussed and real-life examples from the automotive and aerospace industry will be used to highlight advantages and shortcomings of the different approaches.

EnginSoft - Giulio Cenci

Digital Twin, the new dimension of numeric simulation: Methodologies, Opportunities and Experiences by EnginSoft

The media, vendor advertising, academic literature, and more importantly, an increasing number of proactive companies are all discussing the business benefits that can be realized through the implementation of the digital twin and digital transformation, in general. EnginSoft defines the Digital Twin as a dynamic virtual model (often actually a meta-model) that accurately replicates a real-world physical asset, service or process that is in use in the field. The Digital Twin (DT) changes almost simultaneously with the asset's state as it moves through its life cycle; The DT is no longer in the exclusive domain of big businesses: The cost of the enabling technologies for Digital Twins -- sensors, communications, analytics and simulation – have reduced to a point where they can be deployed for almost every asset. Ensuring a Return on Investment There are many moving parts in the implementation of a digital twin and to ensure a return on investment is not always easy, which is why it is not a task to undertake lightly or without the right partner. The use of digital twins needs to be underpinned by sound business strategy that focuses on a specific business target and its assets before digital modelling begins. The true benefit of Digital Twins can only be realized by aligning specific business objectives with the right tools and methodology and combining this with strategically choosing the right people with the right skills and experience to advise and assist you in the process.EnginSoft's methodology places great emphasis on the knowledge of the phenomena related to the asset, going beyond purely statistical and data correlation approaches, in order to really add value to the company's growthIt identifies the key technical factors that create value for the business, and then represents them with digital models that are not necessarily complex. This tradeoff between complexity and business benefits is key. Even short projects can substantially increase business performance by bringing simulation closer to operations," he explains. Our highly-structured technology transfer process and our digital-twin-driven focus on business, represent the greatest value for our customers. To date, actual concrete experience in the use of digital twins worldwide is still limited to the initial phase of a learning curve that offers extreme potential for improvement to those organizations that have embraced these techniques in a business-focused manner. Due to its technical simulation product development background and its position with important technological partners such as Ansys and PTC, EnginSoft is the ideal company to partner with to implement DT projects because its approach bases these solidly on the customer's historical engineering practices and indissolubly merges this knowledge with operations and business insight. DT is not just a process, but a comprehensive multidisciplinary culture The DT is not simply a corporate technical process but represents a comprehensive and multidisciplinary culture that combines engineering, processes, data and people into a new ecosystem capable of growing business through substantiated decisions. The DT draws together managers, technicians and operational staff in data collection and decision- making, and thus becomes the basis of multidisciplinary simulation and technical communication platforms that create a Smart Company Environment targeted at dramatically increasing business through an integrated approach. Every market sector is already being

impacted by these reflections, not least medicine. There were at least six papers presented at the 2018 CAE Conference that addressed the use of the digital twin in the medical field. These techniques have been used in the study, diagnosis and treatment of the human body for years, thanks to the influence of the major international universities. When the DT is generated with sound simulationbased sciences, it enables all these decisions and their consequences to be virtually tested so that more informed decisions can be made faster and better.

SME

Chair: Claudio Arlandini

RED Fluid Dynamics - Riccardo Rossi and Enrico Bezzi

HPC for Industry 4.0: the case of the ARES Design Panther ProgettoUno

In an era of exponential growth of virtualization, the paradigm of product development is shifting more and more towards the use of technologies enabling the design and evaluation of performance without the need to build physical prototypes. This is also the case of the Panther ProgettoUno by Ares Design, a modern supercar taking inspiration from the past, where the aerodynamic development relied solely on the use of Computational Fluid Dynamics (CFD) and High-Performance Computing (HPC). In this presentation, the technology and models used during the development of the Panther ProgettoUno will be presented, from the first drawings to the optimal design.

MADE - Prof. Sergio Terzi

MADE: Competence Center

Presentation of national industry 4.0 competence center: MADE.

MoxOFF - Matteo Longoni

Making the most of mathematics for innovation

To compete on the market SMEs need to focus their resources on the core business development. Especially in the Industry 4.0 framework, where the digital technologies such those based on algorithms, simulations and mathematical modelling are evolving quickly, require customized solutions and yearn computational power. Success stories from industry and EU programmes demonstrate how the access to flexible HPC resources is a key asset to boost the SME potential.

LINCON - Lucia Ramundo (PoliMI)

Maritime 4.0: opportunities from digital technologies adoption

Maritime industry delivers high technological vessels, but it doesn't leverage the benefit of the technology and the collected data for its own good yet. Nowadays the sector is maintaining a traditional design and manufacturing approach, where the vessel is built and sold just as a product and after-sales services are demanded to maintenance professionals, often disconnected from original vessels shipyards. The latest enhancements in the communication connection, overall along the sea coastline, and in the analytics capabilities can now overcome the barriers in adopting the digital technologies in the maritime as well. Starting for main maritime challenges, this session presents SMEs and R&D success stories how vessels designers, shipbuilders, fleet managers and other value chain actors can take advantages from the Industry 4.0 revolution, becoming more and more competitive in the market.

Nokia – Chiara Rampini

Data Scientist profiling at a glance

This presentation is aimed at giving an overview of the different aspect related to the job of the data scientist. In particular what are the key competences, skills, what is the day-to-day work of a data scientist and how to organize a team to industrialize a data science project.

E4 - Fabrizio Magugliani

Why HPC is key for the competitiveness of the industry (and particularly for SMEs) Competitiveness is a key factor for the industry and in particular for SMEs, because SMEs are the backbone of the EU economy accounting for up to two/thirds of all private sector jobs. The most cost effective tool that SMEs have to achieve the competitive edge of the market, which means designing, testing and manufacturing products outplacing the competition, is adopting a simulation-based approach for the development of new products. Simulation fidelity and what-if analysis for realistic simulations require computational resources that a current-generation HPC system can make available without requiring sizable investments. This presentation will show examples of successful implementation of simulation-based product development applying HPC to the design process, and will highlight the benefits in term of shorter time to market, TCO and quality.

EPCC – Gavin Pringle

Fortissimo Marketplace. Indusrty 4.0 experiments in HPC

HPC Europa 3 Alberto Salvadori

HPC simulations of batteries

One of the greatest challenges facing the electric power industry worldwide is how to deliver the energy in a useable form as a higher-value product, especially in the area of renewable energy. By storing the power produced from immense renewable sources off-peak (e.g., daytime for solar energy) and releasing it during on-peak periods, energy storage can transform low-value, unscheduled power into high-value “green” products. Batteries are the most common form of storing electrical energy, and they range in size from the button cells used in watches to megawatt load-leveling applications. The present Li-ion batteries, although commercial realities, are not yet at such a technological level to support renewable energy plants, as well as to efficiently power electric vehicles. Theoretical and computational modeling provide the understanding of the intimate behavior of micro-structures and allow predicting the response of electrodes to different selections of their constituents, thus tailoring and optimizing new materials. The electrochemical and mechanical performances of Li batteries strongly depend on the interactions between macro and micro-scale phenomena. Insertion and extraction of Lithium from electrodes in current commercial batteries take place in active particles, whose size is three order of magnitudes smaller than the battery cell scale. Simulations involving this wide range of scales are inherently expensive, consisting of tens of millions of computational cells and millions of highly nonlinear equations. High-performance computing (HPC) is a necessary resource: by efficiently computing both the macro-scale and micro-scale equilibrium using HPC platforms, parallel multi-scale solvers may be developed for batteries, achieving ideal scalability.

Bi-REX - Stefano Cattorini

Presentation of national industry 4.0 competence center: Bi-REX.

HPC Europa 3 - Federico Perini

Leveraging HPC technology for faster simulations of engine combustion

Multidimensional simulations of internal combustion engines have pioneered the multi-physics application field, as they combine computational fluid dynamics (CFD), sprays, thermo-chemistry and heat transfer in complex geometries with moving boundaries. Driven by tighter emission regulations and the quest for greater fuel efficiency, the frontier of engine combustion technologies is now to blend combustion strategies in a range of increasing in-cylinder reactivity gradients; being able to predict local turbulence, flow and mixing for combustion development is crucial to their success. With increasing power in computing hardware, engine CFD has the potential to replace expensive experimental campaigns, and support and simplify the design process by providing insight that even expensive experimental facilities are not capable of, provided that the right answer is produced in a reasonable amount of time for the combustion engineer. Turnaround times for engine simulations should be well within 10 to 15 hours, i.e., between the time the engineer leaves the office after work and when he/she goes back to it the next day. In order to reduce this time, appropriate usage of High Performance Computing (HPC) resources is crucial: combustion simulations require robust and accurate solvers. In this presentation, we will share what we've learned during a 3-month internship at CINECA, where we worked to scale up the FRESCO engine simulation code for HPC performance. Our experience shows that even with modest changes to the codebase, using HPC-class solvers and preconditioners, we achieved one order of magnitude speed-up in engine combustion simulations and enabled the code to run much larger and more accurate grids.

MaX – CNR – Elisa Molinari

MaX: screening and designing materials with HPC

MaX - Materials Design at the Exascale is a European Centre of Excellence to support the best use and evolution of HPC for materials applications. The talk will present cases of success and opportunities for industrial resaerch and collaboration.