SUPEI
Institute of Systems and Technologies for Sustainable Production

Innovation of manufacturing systems and processes, products and business models to drive and assist manufacturing companies in facing evolving market and technology challenges coherently with economic, environmental and social conditions.

www.supsi.ch/isteps
Institute of Systems and Technologies for Sustainable Production (ISTePS)

The Institute focuses on the innovation in manufacturing systems, processes, products and business models through the development and exploitation of advanced industrial technologies and manufacturing approaches as well as highly qualified human capital.

ISTePS is part of the Department of Innovative Technologies (DTI) of SUPSI (University of Applied Sciences and Arts of Southern Switzerland) employing professors, researchers and engineers with many years of experience in education, training, research and technology transfer towards industry.

The core interests are:
- Digital transformation of production systems
- Industrial Sustainability
- Industrial systems and technologies for additive manufacturing & laser processing
- Modular robotic-based production systems

Such topics are promoted within education and training activities at Bachelor and Master level, through continuous education programmes, and through research and technology transfer activities.

- 4 main scientific research areas
- 55 employees
- 140+ Bachelor students
- 50+ Master students
- 3,6 mio research budget
- 2 research groups (laboratories)
- 20+ research projects running each year
- 120+ industrial, academic and institutional partners
Our competences focus on the design and development of sustainable production systems and value chains.

**Digital transformation of production systems**

The fourth industrial revolution is founded on the convergence between the physical and the virtual world: the first produces an unprecedented amount of data that the latter uses to provide extremely reliable analytics and forecasts. This research area focuses on the development of digital factory models and real factories integration, as well as on modelling and simulating production machines and systems.

**Industrial applications:**
- Manufacturing industries at large
- CNC control designers and manufacturers

**Industrial Sustainability**

Sustainability is now a bottom-line requirement for manufacturers looking for new business opportunities and dealing with customized and human-centric production. This research area focuses on the assessment of complex manufacturing systems, on human centred production and human-robot collaboration, and on the improvement of the sustainability profile of companies, through the development of metrics, Decision Support Systems and specific business models.

**Industrial applications:**
- Manufacturing production systems
- Customized and personalized consumer goods
- Process industries and clusters

**Industrial systems and technologies for additive manufacturing & laser processing**

Innovative Additive Manufacturing (AM) systems adopt several process technologies enabling the manufacture of complex-shaped parts for a wide range of applications. This research area focuses on metal-based additive manufacturing combined with subtractive technologies like ablation and surface structuring, performed with real-time monitoring and adaptive control. It includes design and engineering of machines and mechatronic equipment for AM; development and control of laser-based processes; design, inspection and functional characterization of produced parts.

**Industrial applications:**
- Endo- and exoprosthesis for Medtech
- Motorsport and Aerospace
- Oil&Gas and Maritime
- Mold&Die

**Modular robotic based production systems**

The integration of industrial robots in production systems concurrently considers the manufacturing process to be performed, the environment in which the robot operates and the interaction with other machines and human operators. This research area focuses on the design, development, and integration of custom robotic systems for specific tasks. Solutions include high-performance robot joints, laser and artificial vision equipped systems, mobile maintenance robots for harsh environments, and both modular industrial and collaborative robots.

**Industrial applications:**
- Micro-precision manufacturing
- Soldering and mechanical manipulation for Optoelectronics
- Aerospace and Automotive
Technical Equipment

Own main developments

Mini-Factory I4.0 – It is part of a long-term project of ISTePS and supports applied research, technology transfer and teaching. Its aim is to study and apply modern and advanced production technologies and methods in the context of Industry 4.0. The Mini-Factory creates a platform where researchers, students and industries meet, develop and empower the transfer of knowledge. Here there’s the chance to experience both classical automation topics (PLC, MES and SCADA programming, precision axes control and pneumatics), as well as the most advanced technologies (IoT, vision systems, simulation and digital twin, human-robot collaboration and smart production management systems).

4D Hybrid machine – 5-axis hybrid machine capable of performing metal powder direct laser deposition and laser ablation all in one solution. The machine is equipped for closed-loop control by vision and thermal in-line monitoring and in-process 3D part scan for achieving first time right AM parts.

Cold Spray Gun – Cold Spray is an additive manufacturing technology where powder particles blown at supersonic speed create a deposition layer without the need to use a heat source to melt them. ISTePS developed for this process an innovative gun, which largely surpasses state of the art in terms of deposition rate.

Mobile robot – Robot for autonomous and supervised maintenance in harsh environments, like offshore platforms and gas ducts. The robot is equipped with exchangeable tooling for on-site repairing, a 3D scanner for damage detection and it can operate even on vertical surfaces.

ReRob – Modular, reconfigurable robot platform, where the joints and links type and sequence is flexibly selected basing on the task to accomplish. It guarantees vision-guided accuracy of 5 micrometers in assembly operations.

Other commercial machines, robots and devices

Femtika – Femtolaser based hybrid machine (ablation and deposition) for any material, up to the nanoscale.

Comau – Robot equipped for Cold Spray process.

Kuka – IIWA 7-axis collaborative robot.

Prima Additive – Printsharp 250 powder bed fusion metal printer.

Laserdyne-430 – 3-axis machine for metal powder direct laser deposition, with custom equipment for process monitoring and control.

Inspection equipment including digital and confocal microscopes for micro-scale 3D surface inspection, 3D scanners for medium-scale parts and interferometers for nanoscale surface inspection.
Some Projects

**I4MS–COMPLEMANT – HORSE (H2020)** – Harmonization of the capabilities of collaborative robots with those of human operators thus creating environments where they can interact safely.

**MANU-SQUARE (H2020)** – Creation of a European platform-enabled ecosystem acting as a virtual marketplace that brings available manufacturing capacity, as well as other virtual and physical assets, closer to production demand, creating local and distributed value networks for innovative providers of product-services, and reintroducing unused capacity in the loop.

**RECLAIM (H2020)** – RE-manufaCturing and Refurbishment of LArge Industrial equipment: demonstration of I4.0 strategies and technologies that enable the re-use of older industrial equipment through retrofitting to improve predictive maintenance and operations.

**Femtosurf (H2020)** – The goal is to develop an industrial-grade solid-state 2-3 kW-level fs laser machine suitable for efficient patterning arbitrary shaped metal components with sizes exceeding several meters, while retaining micrometric precision.

**4D Hybrid (H2020)** – Development of a new concept of hybrid additive manufacturing based on the modular integration of components as laser sources, deposition heads, and sensors both into machine tools and onto stationary or mobile robots. The project has been awarded with EU Innovation Radar Prize 2019 in categories Women Led Innovation and Overall Winner.

**Ground Control (SNF)** – Realization of a control system for the Direct Energy Deposition (DED) additive manufacturing technology, based on artificial vision and on machine learning and artificial intelligence techniques.

**Rossini (H2020)** – Design and development of a modular and scalable platform for the integration of human-centered robotic technologies in industrial production environments.

**RECLAIM (H2020)** – RE-manufaCturing and Refurbishment of LArge Industrial equipment: demonstration of I4.0 strategies and technologies that enable the re-use of older industrial equipment through retrofitting to improve predictive maintenance and operations.

**I4MS KITT4SME (H2020)** – The goal is to provide European SMEs and mid-caps with a modularly customizable digital platform, that seamlessly introduce artificial intelligence in their production systems.