UNIVERSITÀ DEGLI STUDI DELL'AQUILA
Prof. Francesco Lambiase
Curriculum scientifico

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Scientific Curriculum - Prof. Francesco Lambiase

Francesco Lambiase is Associate Professor at the University of L'Aquila in the scientific disciplinary sector ING-IND 16 Manufacturing Systems and Technologies, with specialization in **advanced manufacturing processes**, **additive manufacturing** and **innovative joining technologies**.

Teaching Activities

He teaches the following specialized courses:

- "Special Technologies" in the Industrial Engineering Bachelor's Degree
- **"Rapid Prototyping and Additive Manufacturing"** in the Master's Degree programs in Mechanical Engineering and Management Engineering
- **"Advanced Characterization of Additive Manufacturing Components"** in the PhD program in INDUSTRIAL AND INFORMATION ENGINEERING AND ECONOMICS

Research and Development Activities

Since 2003, he has been conducting research and development activities in the field of **advanced manufacturing processes**, with particular focus on **additive manufacturing**, **numerical modeling**, **machine learning** and **innovative joining processes**. His expertise spans from product/process prototyping to advanced materials characterization.

Additive Manufacturing and Advanced Prototyping

He has developed **Additive Manufacturing processes for large-scale components**, contributing significantly to innovation in the **product/process prototyping** sector. His research includes:

- Development of processes for manufacturing **long fiber composite components** through additive technologies
- **Additive processes for high-performance technopolymers in aerospace applications**, focusing on materials such as PEEK, PEI and other advanced thermoplastic polymers for

structural and functional aerospace components
- Development of **innovative non-destructive characterization methodologies** for additive components
- **Laser surface treatments** to improve surface finish of polymeric components manufactured by **Fused Deposition Modeling (FDM)**
- Development of **rapid prototyping systems** for advanced industrial applications

Plastic Materials Recycling and Sustainability

He has developed **thermomechanical recycling processes for thermoplastic materials**, contributing significantly to manufacturing process sustainability:

- **Thermomechanical recycling processes** for recovery and valorization of thermoplastic material processing waste
- Development of **characterization methodologies** for recycled thermoplastic materials, evaluating the influence of recycling cycles on mechanical and thermal properties
- **Process parameter optimization** for recycling high-performance technopolymers through **machine learning** approaches
- Integration of **recycled materials** in **additive manufacturing** processes, with particular focus on production chain sustainability

Advanced Joining Processes and Numerical Modeling

He is a pioneer in developing **innovative thermomechanical joining processes**, with particular expertise in:

Friction Assisted Joining (FAJ): In 2016, he developed and patented this revolutionary process, designing an **instrumented prototype machine** for manufacturing hybrid metal-polymer and metal-composite joints. He demonstrated process applicability to high-performance materials (aerospace aluminum alloys, titanium, polyamide, PEEK and composites).

Friction Spot Welding and Friction Spot Stir Welding: He developed **prototype equipment** for instrumented testing, studying process conditions influence through **advanced numerical modeling** and **machine learning techniques for process optimization**.

Laser Direct Joining: Through **experimental analysis** and **numerical model development**, he investigated thermo-physical aspects of metal-polymer joints, developing **advanced characterization methodologies** and **Artificial Intelligence-based models**.

Advanced Mechanical Clinching: He used **experimental methodologies** and **advanced process modeling** to extend applicability to high-performance materials and hybrid joints, developing **predictive models** and **AI-based optimization systems**.

Machine Learning and Numerical Modeling

His expertise in **machine learning** and **numerical modeling** is evidenced in:

- Development of **Artificial Intelligence-based process optimization solutions** for joining processes
- **Calibration and validation of numerical models** through experimental analysis
- Development of **genetic algorithm-based predictive models** for forming processes
- **Automatic process design methodologies** through advanced numerical approaches
- Use of **Digital Image Correlation (DIC)** for local mechanical characterization

Advanced Manufacturing Processes

He has significantly contributed to the development of **innovative manufacturing processes**:

Incremental Forming: Development of **flexible forming processes** for polymeric and thermoplastic composite components, with **simulation models** for incremental forming and vacuum forming.

Laser Forming: Experimental studies to determine strain and stress states, developing an **instrumented prototype**with process parameter control and **numerical simulation-based predictive models**.

Automatic Design: Development of **predictive numerical models** and **automatic methodologies** for plastic deformation processes (hot rolling, roll drawing).

Surface Treatments and Functionalization

Experimental activities for:

- Manufacturing **functionalized structures** to improve adhesion between dissimilar materials
- **Laser cleaning** for composites
- Improvement of **surface finish** of additive manufacturing components

Advanced Characterization and Materials Development

Expertise in **conventional and non-conventional characterization** of materials, focusing on:

- Development of **innovative non-destructive characterization methodologies**
- **Advanced mechanical characterization** through innovative experimental techniques
- Analysis of material properties for **additive manufacturing** and structural applications

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