


# SoFIA

## Solutions pour la Fabrication Industrielle Additive métallique - Solutions for Industrial Metal Additive Manufacturing




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**SoFIA ("SOLutions pour la Fabrication Industrielle Additive métallique" - *Solutions for Industrial Metal Additive Manufacturing*)** is an applied research program for metal additive manufacturing.

SoFIA's ambition is to contribute to the development of this technology by working on the entire metal additive manufacturing value chain (powders, machines, processes). To that end, SoFIA fosters synergies between the skills provided by its high-level partners: industrial players, centered around the Fives Michelin Additive Solutions joint venture (Aubert & Duval, ESI Group, FUSIA, Michelin, Safran, VOLUM-E, Zodiac Aerospace) and academic institutions (the CNRS and the following research universities: Centrale Supélec, Centrale Nantes, Ecole Polytechnique, ENS Paris-Saclay (ENS Cachan), University Paris Diderot, University of Paris-Sud, and Pierre and Marie Curie University – Paris VI).





## SoFIA's ambition

SoFIA is a 6-year applied research program which covers the entire metal additive manufacturing value chain, from powder to the end user, with a focus on material-energy interactions.

It aims to develop technological bricks which can be used to manufacture robust parts at competitive prices, particularly to meet the requirements of the aviation industry. Work will focus on 4 key areas:

- Perfecting metal powder ranges
- Improving the productivity of additive manufacturing machines by optimizing the material / process pairs and developing new energy sources
- Designing new ranges for parts with optimized technical and economic characteristics, with a view towards digital continuity
- More broadly, increasing the knowledge of the HSE risks linked to metal additive manufacturing in order to create a repository.

These technological bricks could be integrated into machines sold starting in 2018.



# The SoFIA partners

SoFIA fosters synergies among the skills and experiences of high-level players, which cover the entire value chain from powders to finished parts. SoFIA combines a detailed understanding of the materials and processes involved with end users' needs for the parts made with this technology.

The program, which was initiated by the Fives Michelin Additive Solutions joint-venture, is based on the expertise of partners including:

- industrial players: Aubert & Duval, ESI Group, FusiA, Michelin, Safran, Volume, Zodiac Aerospace.
- academic institutions: The CNRS and research universities (Centrale Supélec, Centrale Nantes, Ecole Polytechnique, ENS Paris-Saclay (ENS Cachan), University Paris Diderot, University of Paris-Sud, Pierre and Marie Curie University – Paris VI).

SoFIA is certified by the following competitive clusters: ViaMéca, Aerospace Valley, ASTech Paris Region, NAE and Mov'eo. It is funded by Bpifrance and the Auvergne – Rhône-Alpes region.

## Industrial Partners

### **Aubert & Duval**

AUBERT & DUVAL, an ERAMET group company, designs and creates hi-tech metallurgical solutions using high-performance steels, superalloys, titanium and aluminum, in the form of parts, long products and powers for the most demanding industries, including the aerospace sector.

AUBERT & DUVAL brings its expertise in metal powders for metal additive manufacturing to bear in its work on developing new grades and optimizing powder performance to obtain the best possible material / process pairs.

### **ESI Group**

ESI Group is a leading innovator in Virtual Prototyping software and services. Specialist in material physics, ESI has developed a unique proficiency in helping industrial manufacturers replace physical prototypes by virtually replicating the fabrication, assembly and testing of products in different environments. Virtual Prototyping addresses the emerging need for products to be smart and autonomous and supports industrial manufacturers in their digital transformation.

## **Fives Michelin Additive Solutions**

With the AddUp brand, Fives Michelin Additive Solutions offers global industrial solutions in metal 3D printing, from the design and supply of machines and associated services and advice through production of parts.

Already recognized in the industrial additive manufacturing field through its founders, Fives and Michelin, the AddUp offer stands out for its industrial approach, which is tailored to each customer's projects, and the assistance it provides with finding the right technological and financial solutions.

## **FUSIA**

FusiA is a member of the FUSIA GROUP, a Franco-Canadian group with over forty years of experience in precision machining and welding. With 100 employees and sales of over €10 M, the FUSIA GROUP is an international expert in additive manufacturing for the Aviation, Spatial, and Defense industries, with clients including SAFRAN, AIRBUS, and ZODIAC AEROSPACE.

FusiA, which is involved from the R&D stage through mass production of parts, is ISO 9001 and EN 9001 certified, with a qualified procedure for the aviation sector.

The SoFIA project offers the group an opportunity to accelerate the implementation of its strategic roadmap for industrialization of its production.

## **Michelin**

Since 2007, when it took its first steps in metal additive manufacturing, the Michelin Group has acquired a unique level of experience in designing and mass producing complex mold components, in addition to using the components on an industrial scale for day-to-day tire production. Michelin now achieves high productivity and high quality of the parts it manufactures.

- Multi-machine production workshop with auxiliary workstations + post-processing,
- Automated production cell with integrated post-processing and inspections.

## **Safran**

Safran is an international hi-tech group and a leading manufacturer for the Aviation, Spatial, Defense and Security industries.

In order to follow market trends and remain competitive, Safran is innovating and developing technologies for the products and service of the future. It invested over 2 billion euros in R&D in 2015, and over 21% of its employees work on R&D programs.

## **Volum-E**

VOLUM-e 3D Complex Production, a specialist in Additive Manufacturing of plastic, ceramic and metallic parts for over 25 years, contributes to the dynamism of the SoFIA project.

Its teams bring the consortium their expertise in re-design and functional engineering, design and execution of Additive Manufacturing operations, and fine-tuning the production of individual or mass-produced parts.

## **Zodiac Aerospace**

Zodiac Aerospace is a world leader in advanced solutions that improve comfort and quality of life onboard aircraft, as well as hi-tech systems that improve aircraft performance and flight safety.

Zodiac Aerospace, which builds close relationships with its customers, both airlines and aircraft manufacturers, places innovation at the heart of its initiatives. Additive manufacturing is one of the technologies that will make it possible to meet the complex requirements of the aircraft industry.

# Academic partners

## **CNRS**

The CNRS is a French public research institution, governed by the Ministry for Higher Education and Research. It produces knowledge to serve society. With a headcount of close to 32,000, a 2015 initial budget of 3.3 billion Euros, including 769 million euros in CNRS-generated income, and locations across France, the CNRS operates in all fields of knowledge, through a network of over 1,100 laboratories. With a portfolio of 5,629 families of patents, 26 framework contracts with CAC-40 companies, 376 joint intellectual property contracts, over 1,200 start-ups created, over 120 CNRS/business joint research structures, an annual average of 43,000 publications per year and 18 Nobel Prizes, the CNRS has a long-standing tradition of excellence, innovation, and transfers to the business community.

As part of the SoFIA program, the CNRS will be bringing together the skills of the following institutions:

- **Ecole polytechnique (CMAP and LMS)**  
Skills in topological optimization of structures and modeling and prediction of phenomena which impact the durability of the materials and manufactured parts in usage conditions.
- **ENS Paris Saclay (Farman Institute and especially LURPA)**  
Skills in primitive command optimization and modeling of multi-physical constraints for process parameter determination in order to optimize product quality.

- **Nantes EC (IRCCYN and GEM)**  
Skills in modeling and information systems, integration and optimization of the overall digital chain, decision-making support methods and digital process simulation, optimization and real-time control techniques using digital nomograms generated using model reduction techniques.
- **University of Paris-Sud (C2N, LPGP, ICMMO)**  
Skills in energy source optimization (photonics, e- or ionics), energy / material interaction modeling, and characterization of microstructures and materials properties.
- **CentraleSupélec (L2S)**  
Skills in modeling, signal processing, and command rule development to optimize the performance of machine axis control cards and manage energy sources.
- **University of Paris Diderot and Pierre and Marie Curie University (LJLL)**  
Skills in topological optimization and digital modeling.