

THE **BOOK** OF **Innovations**

In order to meet the technological and societal challenges of each era, engineering has always been able to rely on its ability to innovate, particularly in the design, study or construction of structures, equipment or products.

Whatever the field in which SEGULA Technologies operates - Automotive, Aeronautics, Energy, Naval, Rail or Oil & Gas - the DNA of our group is to find the solutions to bring these projects to life and support their implementation in the most competitive way possible. It is therefore natural for us to place innovation at the heart of our development strategy and our growth dynamic.

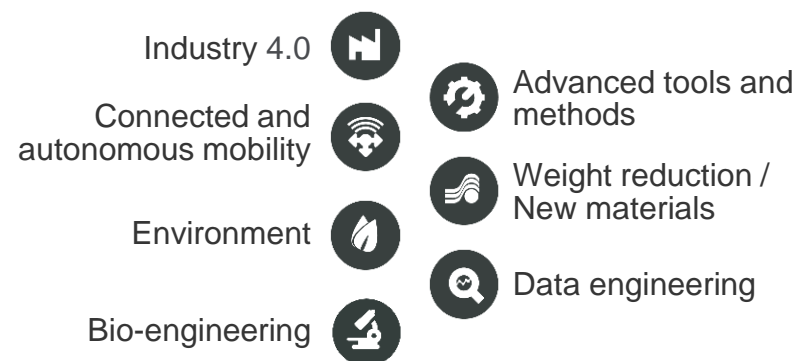
In ultra-competitive markets, our customers need to innovate quickly. To support them, we are a permanent source of innovative solutions, based on:

→ **the efficiency of our organisation:** our Research and Innovation (R&I) located at the heart of our branches, close to customers and operational staff, is essential for understanding our customers' needs. This proximity also enables us to work closely with SMEs, start-ups, laboratories and competitive clusters, thus promoting cross-fertilisation and creativity.

→ **the talent of our engineers,** and the passion that drives them: more than 200 projects are developed each year by our R&I teams, projects that unite skills around major challenges in the design of new products and systems, new services or new methods.

→ **open innovation:** alliances and large-scale collaborative projects are formed with renowned customers and partners, enabling us to innovate quickly by capitalising on new synergies.

Aware of the fact that our engineers can contribute to the preparation of what tomorrow's world could be like, our group is particularly committed to **7 thematics**:



Our Book of Innovations therefore aims to present you in a simple way some of the current innovations developed by our R&I teams.

We hope that this information will enable you to understand a new aspect of our group, that of our ability to constantly innovate in order to anticipate and accompany the changes in the world of industry.

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(click to read more)



Industry 4.0

Advanced tools
and methods



Connected and
autonomous mobility

Weight reduction /
New materials

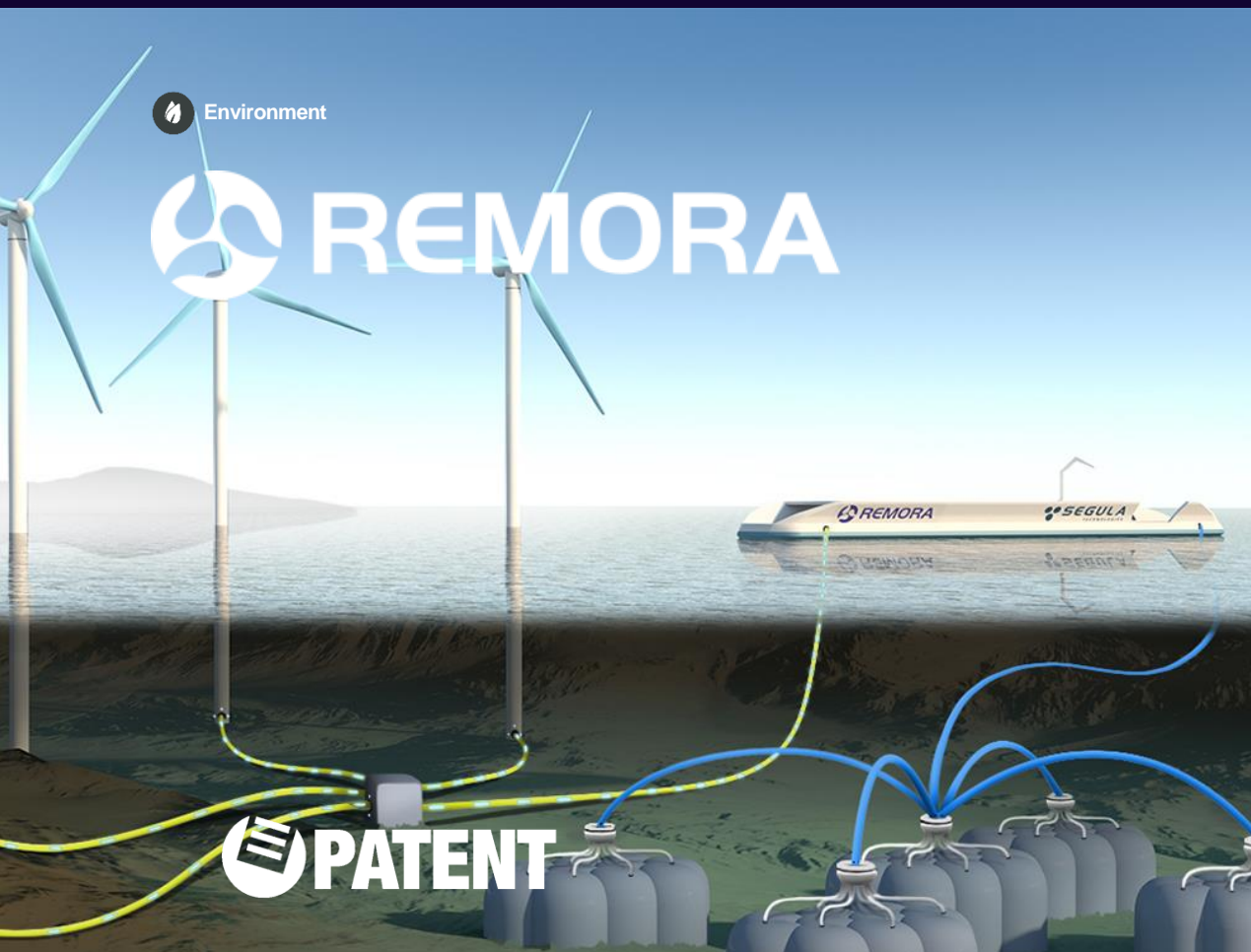


Environment





Data engineering



Bio-engineering



HIGH-EFFICIENCY OFFSHORE ELECTRICITY STORAGE

-  The need for energy storage is growing due to the increasing share of intermittent renewable energies in the energy mix.
-  The REMORA project aims to meet the flexibility needs of the networks by storing electrical energy at sea in the form of compressed air, with an overall efficiency target of 70% and a capacity around one hundred MWh.
-  REMORA is based on a process developed and patented by SEGULA Technologies based on the principle of isothermal air compression. Following the successful testing of an initial small-scale land-based prototype, the design of a larger-scale offshore demonstrator has just been launched. It will be installed by 2023.
-  Highly efficient storage, increased network flexibility, synergy with marine energies.
Use of standard and robust technologies, installation in accessible areas at sea, modular power and capacity as required.
A non-polluting process based on air and water, visual discretion, completely inert underwater equipment.



Project leader:
SEGULA
Technologies



Partners:
CETIM, IMTA,
IREENA, GEPEA,
ICAM, ADEME



Planning:
Prototype 2020
Sea Demonstrator
2023



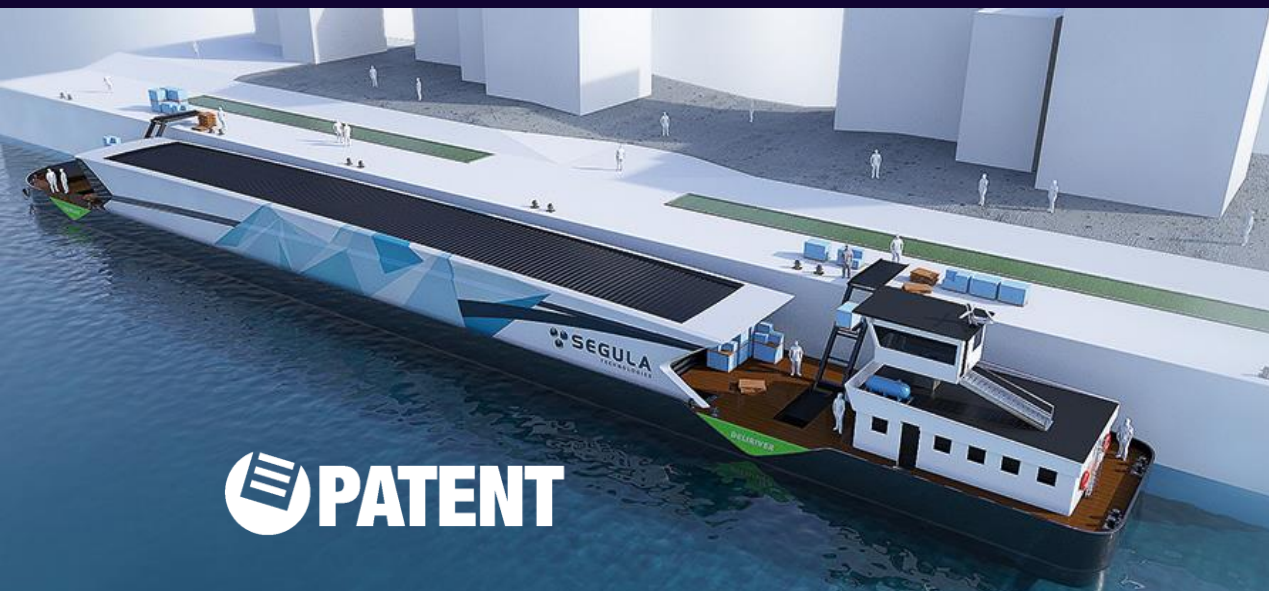
Competencies:
Thermal, Electronics power,
Hydraulics, Naval Architecture

🌿 Environment

📶 Connected and autonomous mobility

GREEN DELIRIVER

Inland waterway logistics



PATENT



Project leader:
SEGULA
Technologies



Partners:
GPS&O, GRDF,
HAROPA, COALIS,
St-Gobain, Syctom,
Total, VNF



Competencies:
Naval architecture, Energy efficiency,
Logistics, Design

RIVER SOLUTION THE CLEAN URBAN LOGISTICS



The explosion of e-commerce has strongly developed alternative logistics needs linked to the delivery of goods, road transport being the 2nd largest CO₂ emitter in the world.



GREEN DELIRIVER aims to ensure the preparation, transport and storage of goods by river and then by electric conveyor to the heart of urban centres, reducing the number of trucks in the city.



GREEN DELIRIVER is equipped with a hybrid gas-electric motorisation, photovoltaic solar panels and batteries that reduce energy consumption.



Reduction of pollutant emissions, reduction of noise pollution, decongestion of cities, design that integrates perfectly into the urban landscape and integrated logistics eliminating the need for a specific infrastructure for unloading.



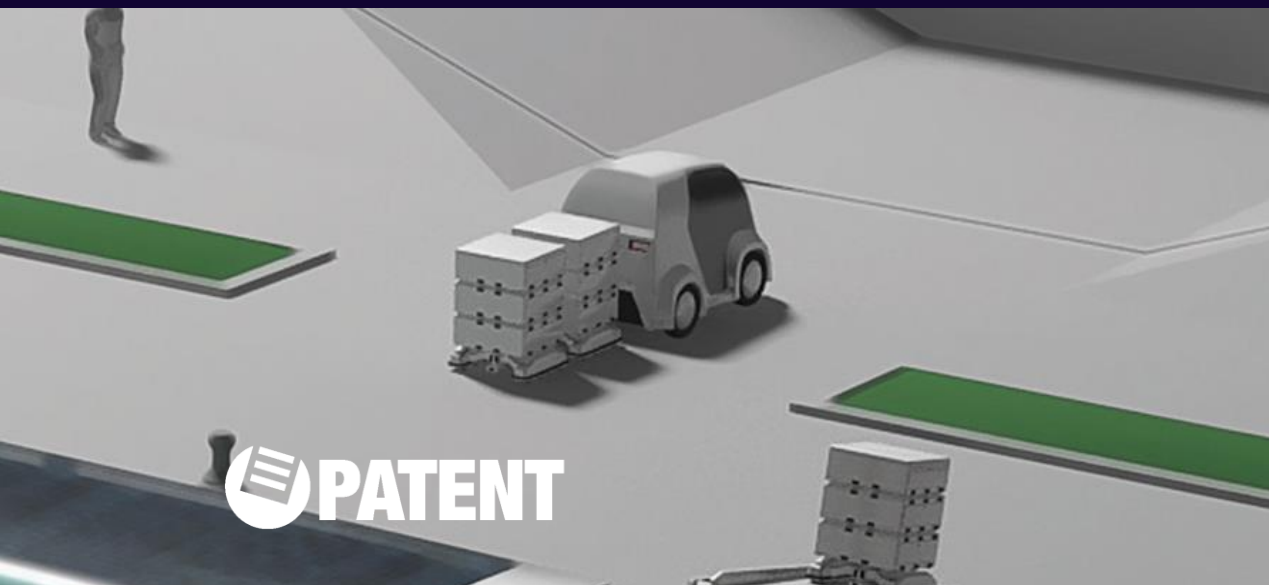
Environment



Connected and autonomous mobility

GREEN DELIRIVER

Autonomous Conveyor



AUTONOMOUS CONVEYORS FOR THE LAST KILOMETRE: INTELLIGENT GOODS MANAGEMENT



The explosion of e-commerce has strongly developed the alternative logistics needs linked to the delivery of goods. Road transport is the world's 2nd largest CO₂ emitter.



The GREEN DELIRIVER last-km electric conveyors are designed to ensure the loading and delivery of goods to the heart of urban centres, thus reducing pollution and traffic.



The GREEN DELIRIVER last-mile conveyors are autonomous loading systems that are loaded directly onto a ship/train/truck. Once they arrive at the place of delivery, they reach the delivery points. The battery is recharged during the unloading and loading of the parcels.



Reduction of pollutant emissions, reduction of noise pollution, decongestion of cities, integrated logistics eliminating the need for a specific infrastructure for unloading.



Project leader:
SEGULA
Technologies



Partners:
GPSEO, NOVALOG,
HAROPA



Planning:
Prototype 2018



Competencies:
Systems architecture,
Energy efficiency, Mechanics,
Logistics, Design



Environment

PAC

DIMENSIONING AND RELIABILITY OF FUEL CELLS

- ? The electrification of transport requires more efficient and environmentally friendly power sources. Fuel cells are therefore an ideal solution, increasing autonomy while reducing recharging time and the use of polluting batteries.
- 🔄 The aim of this project is to develop a new architecture of fuel cell systems in order to ensure independent control of the different cell packs, thus improving reliability and service life.
- 💡 SEGULA is developing tools for the quick pre-dimensioning of hydrogen vehicles and more particularly of the PAC - battery technologies.
- 👍 Improvement of vehicle performance (Vehicle Autonomy).
Reduction of maintenance costs.
Optimisation of energy chain reliability and lifetime



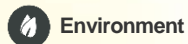
Project leader:
SEGULA
Technologies



Partner:
FCLAB-UTBM



Competencies:
Electrochemistry, Power electronics,
Thermal, Fluidic, Mechanical



Environment



Bio-engineering

BIOFILTRATION



FILTRATION OF AQUEOUS EFFLUENTS BY MICROORGANISMS



During the various industrial processes, the effluents are treated and then injected back into the process or directly into nature. As regulatory requirements are becoming stricter, it is therefore necessary to improve the filtration of these effluents.



The objective of the BIOFILTRATION project is to develop a new method of effluent treatment. It consists in using the natural capacity of some microorganisms to fix a large variety of inorganic and organic molecules (metals, oxides, radioelements...).



SEGULA Technologies studies the diversity of microorganisms that can purify effluents. The Group determines the microorganism and treatment process best suited to the industrial problem.

This new filtration process is adaptable to high temperatures, high pressures and a high radioactive environment.



Development of filtration processes specific to each industrial problem.

Reduction of costs and treatment time.

Filtration of effluents that cannot be treated with current processes.
Possible recovery of inorganic and organic pollutants and revalorization.



Project owner:
SEGULA
Technologies



Partner:
MAP Laboratory
M2E Team
(INSA LYON)



Planning:
Proof of concept
obtained in 2019 for a
specific industrial issue



Competencies:
Waste recovery, Depollution,
Microbiology, Biotechnologies



SOxLOW



ON-BOARD DESULPHURISATION OF MARINE FUELS

- New rules stemming from the recommendations of the International Maritime Organisation (IMO) have recently been put in place to limit sulphur oxide emissions from ships in order to improve air quality and reduce ocean acidification.
- SOxLOW is a desulphurisation system for marine fuel oils (heavy refinery products) for continuous treatment on board ships. One aim of the project is to recover sulphur so it can be used for further processing.
- SEGULA Technologies has developed methodologies for the analysis of sulphur compounds, adapted to marine fuel oils and necessary for their treatment. The Group is currently conducting hydrocarbon depollution experiments.
- Possibility of adapting the system to existing vessels, functional on all types of heavy fuel oils, reduced environmental and health impacts in compliance with various regulations.



Project leader:
SEGULA
Technologies



Partners:
UCCS, IPREM



Competencies:
Chemistry, Processes, Ships

🌿 Environment

📶 Connected and autonomous mobility

ODOT



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BALLAST MANAGEMENT SOFTWARE FOR 5% FUEL SAVINGS

- ❓ Environmental and health concerns and the rising cost of fossil fuels make the reduction of energy consumption of ships a priority.
- 🔄 The ODOT (Operational Displacement Optimisation Tool) project aims to provide crews with a decision support tool to better manage cargo (cargo, consumables) and thus reduce energy consumption. It has been selected as part of the H2020 JOULE European collaborative project.
- 💡 Using complex algorithms, the ODOT module optimises the distribution of masses in the ship, which reduces the resistance to forward motion and leads to energy savings of 5%.
- 👍 Low financial investment, immediate return on investment, quick takeover, can be used on existing vessels.



Project leader:
SEGULA
Technologies



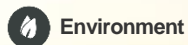
Partners:
STX France,
Brittany Ferries
EU H2020



Planning:
Product marketed



Competencies:
Naval architecture,
Hydrodynamics,
Software Engineering



ELIOS



TANDEM PHOTOVOLTAIC ARCHITECTURES

- Photovoltaic cells currently developed to work in tandem are very unstable. With the innovative use of materials such as perovskite, these instabilities can be eliminated.
- Stabilisation through the use of perovskites seems to be the most promising. However, stable, low-cost structures suitable for this type of tandem cell have never been proposed.
- The **ELIOS** project is oriented towards a transparent carbonaceous electrode allowing the development of a tandem structure with a crystalline silicon cell. This study mixes graphene deposits and perovskite technology.
- Significant increase in yield.
Low cost of implementation.



Project leader:
SEGULA
Technologies



Partner:
LPICM



Planning:
2019-2022



Competencies:
Photovoltaics
Experimental methods

🔥 Environment ⚙️ Advanced tools and methods 📶 Connected and autonomous mobility

E3S

ENERGY SMART SAILING SHIP

- ❓ A sailing ship is isolated from any energy supply during its navigation. Today's environmental concerns make intelligent management of energy flows essential, from environmentally friendly energy sources, while guaranteeing optimum safety and comfort for passengers.
- 🔄 E3S is an onboard energy management tool that includes a computer with Artificial Intelligence and a Human Machine Interface interacting with the passengers.
- 💡 An optimisation algorithm defines and proposes the implementation of an energy management strategy, adapted to the global conditions of navigation in real time.
- 👍 E3S is a system that can be adapted to the configuration of the sailing ship, ensuring the availability of energy on board, optimal comfort and maximum passenger safety throughout the navigation.



Project leader:
SEGULA
Technologies



Competencies:
Control & Command, Operational Research,
Artificial Intelligence, Human Machine Interface

🔥 Environment ⚙️ Advanced tools and methods 🔍 Data engineering

ATARA



Project leader:
SEGULA
Technologies



Partner:
Lacs Sentinelles,
University of
Catalonia
French Biodiversity
Agency (OFB)



Competencies:
Simulation, Limnology,
Hydrodynamics, Water quality,
User interface, Energy

MANAGEMENT OF WATER RESOURCES

- ?

Climate change and human activity are having an increasingly important impact on ecosystems and on services they provide (supply and control). Modeling tools (1D to 3D) supported by optimization algorithms were developed for ecological management of aquatic systems and for preventing quantitative and qualitative water variations (flood prevention, turbidity monitoring, irrigation management, hydroelectric resources optimization, etc.).
- 🔄

The ATARA project (Assistance Tool for wAter Resources mAnagement) is based on the development of numerical modeling tools of hydro-bio-geochemical modeling of water bodies (lakes and reservoirs). All tools aim at estimating impact of human activities and climate change on water resources and at optimizing water use.
- 💡

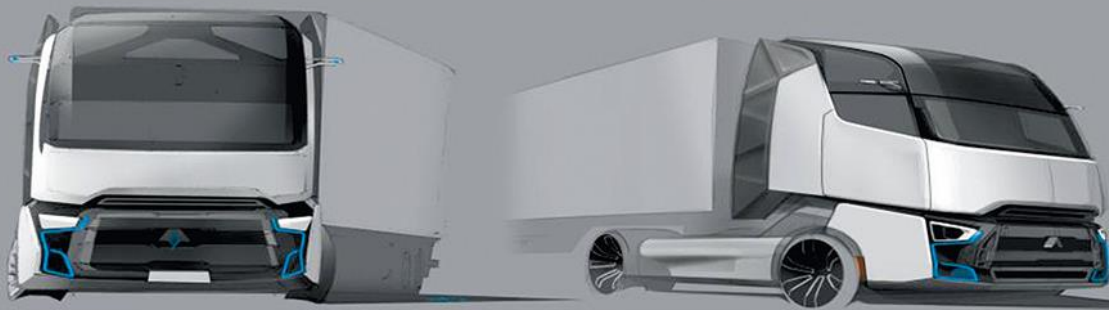
This project focuses on the development of hydrodynamic and water quality modeling tools. They exist at the macro-scale of a region (1D) and at the micro-level of a lake ecosystem (2D and 3D). These models are integrated into an interface enabling analysis of the results via statistical tools synthesizing the information, from in situ measurements and from national environmental scientific databases.
- 👍

Provision of methods and tools, enabling impact modeling of human activity on water resources or other phenomena on water retention infrastructure, and optimizing expected services supplied by these ecosystems.

🌿 Environment

🏗️ Weight reduction / New materials

COMPOSITE CAB



 **PATENT**



Project leader:
Renault Trucks



Partners:
Solvay, PO, Altair,
Mecaplast, Saertex,
Addiplast, Insa, Isat



Competencies:
Composite Design,
Eco-Design, Crash
Calculation, LCA

USING COMPOSITES TO PRODUCE A 30% LIGHTER TRUCK CAB



Road transport is facing major societal and technological challenges. It must solve the paradox of achieving an optimal load capacity while minimising vehicle weight.



COMPOSITE CAB aims to reduce fuel consumption while increasing a lorry's load capacity. The project focuses on reducing cab weight and incorporating various features using composites.



SEGULA Technologies has leveraged its expertise in computation and life cycle analysis (LCA) in order to re-design the rear section of the cab using composite sandwich materials. This solution has not only led to a significant reduction in weight but also the integration of new thermal and acoustic features and a non-mechanical sleeper system.



This project has resulted in a cab that is 30% lighter. The patented sleeper design is covered under an operating license negotiated with Renault Trucks and can be offered as a solution in other sectors.

🌿 Environment

🔧 Weight reduction / New materials

FLEXI-TRUCK



Project leader:
SEGULA
Technologies



Competencies:
Mechanical design, hydraulic,
numerical calculation in statics.

A TRUCK THAT ADAPTS TO ITS LOAD AND ITS ENVIRONMENT



In France, 75% of the transport of goods is carried out by lorries, with a high environmental impact as a result. Trucks of different lengths are used to travel in cities or on highways, forcing the transfer of goods from one vehicle to another on the outskirts of urban centres.



The aim is to reduce energy consumption and the emission of pollutants from freight transport. To achieve this, SEGULA proposes a flexible truck whose structure is adapted to its cargos and delivery locations, thus limiting the transshipment of goods.



The truck's chassis is removed. Its function is then integrated into the load compartment and other vehicle components (cab, engine, etc.).

Each vehicle combines three reversible configurations depending on the area of use and its load: long-haul truck with trailer for the highway, single vehicle for deliveries in town and compact when empty.



Modular and lightweight transport solutions with a low ecological impact. Reduction of nuisances and operating costs linked to the transport of goods.



Connected and autonomous mobility



Advanced tools and methods

STABILOAD

Stabiload



Project leader:
SEGULA
Technologies



Clients:
Brittany Ferries,
PIRIOU, MCM, French
Naval Forces...



Planning:
Product marketed



Competencies:
Naval Architecture, Stability,
Software Engineering

ON-BOARD LOAD AND STABILITY CALCULATOR



The loading of ships must comply with the stability criteria defined by the International Maritime Organisation, but also the proper distribution of stresses on the ship's structure.



STABILOAD is a modular and connected on-board load and stability calculator. It allows the simulation of the ship's equilibrium and the resistance of the structure, as well as the verification of stability criteria.



It performs stability calculations in an intact state, but also after damage (IACS type 2, 3 and 4), with calculations of the liquid hulls and the resistance of the structure. STABILOAD simulates flooding suits while being connected to the ship's sensors. It has a return to port after damage module (SRTP).



Improved safety, quick completion of the loading plan (remote gauging, connection to ferry booking services), decision support in the event of damage, customisable software and load optimisation modules.



Connected and autonomous mobility

LI-FI CAR

CAR-TO-CAR COMMUNICATION USING LI-FI



The development of driver assistance systems is a major challenge for car manufacturers who must meet increasing safety objectives (accident reduction).



The objective of this project is to design a system for real-time transmission of vehicle to vehicle data in order to avoid possible collisions.



SEGULA has designed a system that uses Li-Fi technology to transmit data between vehicles via the front and rear lights that are already on the vehicle. This system can be used to maintain suitable distances between two vehicles, and in the future, it can be used to create convoys of partially autonomous vehicles by transferring data between the lead vehicle and those following behind.



Cost-effective technology, safety.



Project leader:
SEGULA
Technologies



Competencies:
Embedded systems,
Dependability



Connected and autonomous mobility



Advanced tools and methods

DESIS



NON-CONTACT AND REMOTE DETECTION OF VITAL SIGNS



Contactless monitoring of vital signs of people is an essential tool for the safety of vehicle drivers (trains, cars, trams, planes, etc.) thanks to the collection of real-time information on physiological characteristics.



The DESIS project aims to develop techniques based on the notion of cyclostationarity of vital signals to obtain information on the heartbeat or breathing of drivers without being dependent on the noise of the targeted application.



The project **DESIS** is based on the development of a functional system coupled with a data acquisition and processing methodology, enabling real-time analysis and capable of detecting alarming variations in vital signs (abnormal heartbeat or breathing, characteristic peaks in signals...).



Non-invasive (no contact), effective and reliable (low false detection rate), low cost.



Project leader:
SEGULA
Technologies



Partners:
IFSTTAR /IEMN



Planning:
2018-2021



Competencies:
Electronic systems,
Data processing

Connected and autonomous mobility

IMADRON



SEMI-AUTOMATIC PILOTING OF A DRONE IN EXTREME CONDITIONS



Drones are used to capture images of the surfaces of engineering structures (which are then processed to analyse their condition) in inaccessible and difficult terrains.



The objective of this project is to develop a reliable means of inspecting engineering structures, using an algorithm which factors in the parameters that can influence a drone's flight path (wind gusts, etc.) in order to produce a 3D reconstruction in post-processing.



SEGULA has installed a semi-automatic piloting system which lets the drone scan the surface to be inspected without the risk of missing shots as it reacts to weather conditions. Segula has incorporated image processing to calculate ego-motion and control trajectory.



Obstacle detection in all directions without previous familiarity with the inspection area.



Project leader:
SEGULA
Technologies



Partners:
Technidrone



Competencies:
Embedded systems,
Image processing





Industry 4.0

ATLAS



 **PATENT**

A COLLABORATIVE, AUTONOMOUS INDUSTRIAL DRONE

-  The factory of the future will have to be more flexible and modular if it is to adapt to variations in pace and products.
-  The objective of this project is to develop an autonomous industrial drone to take the place of conventional conveyor belts on assembly lines.
-  ATLAS is a compact, smart, collaborative drone equipped with lifting mechanisms. 4 drones can lift a vehicle to a height of 1.80m. They can manoeuvre seamlessly along the assembly line.
-  A very flexible solution that can be transferred to other activity sectors, economic savings due to a reduction in heavy infrastructures.




Project leader:
SEGULA
Technologies





Competencies:
Automation, Industrial IT,
Embedded systems, Robotics




OPTIMISATION OF TRAINING MODULES IN EXTENDED REALITY (XR)

- 

In order to remain competitive or for safety reasons, employee training for the use of new tools or processes is essential. Industries are looking for methods to reduce lead times and costs.
- 

The aim of this project is to propose a method for creating training modules that are scalable, interactive and adaptable according to the user and their skills.
- 

XR Digital Learning is an “Intelligent” Augmented Reality training module.
This is an automatic adaptation of the training level (beginner, intermediate or expert) to the user. The quantity and level of the instructions displayed vary according to the learner's responses so as not to expose the learner to cognitive overload. This work is continued in Virtual Reality.
- 

Reduction of training time and costs, contextualisation in an environment visually close to the physical location, easier acquisition of skills, decentralised training.



Project leader:
SEGULA
Technologies



Competencies:
Extended Reality (Virtual Reality
and Augmented Reality)

Industry 4.0 Data engineering Advanced tools and methods Connected and autonomous mobility

PREMCO



PREDICTION OF DANGEROUS MOVEMENTS OF PEOPLE NEAR THE RAILS BY STEREO-CORRELATION

- ? With a view to making vehicles increasingly autonomous, it is essential to strengthen on-board safety systems and, in particular, solutions for predicting potential hazards.
- PREMCO proposes to equip vehicles with a system for monitoring and anticipating the movements of objects surrounding them (pedestrians, cars, bicycles).
- Based on the principle of stereo-correlation processing (simultaneous video processing of the scene by 2 cameras), SEGULA Technologies has developed an algorithm for predicting the trajectories of moving objects.
- Real-time solution, increased security.



Project leader:
SEGULA
Technologies



Competencies:
Video processing,
Detection of moving objects

Industry 4.0

KITTING

AUTOMATED KITTING IN AN ASSEMBLY WORKSHOP



The number and variety of components are increasingly important in factories. Putting the assembly kits together manually is a complicated and time-consuming task. The challenge is to save time and eliminate mistakes.



The objective of this project is to design a kit-making robot that works directly from factory stocks.



This work has resulted in the design of the most compact autonomous system to date. It can grip components up to 8 kg in weight and at a height of up to 4m. It uses the “jamming gripper” to grab a wide range of components. With this system, several robots can work together if required.



Considerable time savings, fewer human errors and less heavy work for operators.



Project leader:
SEGULA
Technologies



Competencies:
Supply chain, Automation,
Lean manufacturing

Industry 4.0

DATALOGIC

REAL-TIME FLOW MANAGEMENT

- ? There is currently no system that gives a consolidated view of all the flows required for a factory to run smoothly. The development of LEAN methods in factories requires the development of a powerful system to supervise and prioritise the huge amounts of data circulating in real time.
- 🕒 This project aims to develop software to give a real-time view of flows in production plants (storage areas, assembly workshops), thereby optimising operations.
- 💡 This global system catalogues all the incoming stock and flow data and offers an interactive MMI, which allows the user modify flow traffic from their terminal, at their leisure.
- 👍 Real-time data sharing, optimisation of information to operators, monitoring of the smooth running of activities, detection and warning when operations are abnormal, better view of the supply chain.




Project leader:
SEGULA
Technologies



Planning:
Static view diagrams:
2019







Competencies:
MMI, Supply chain, Automation,
Lean Manufacturing

 Industry 4.0

IMACAR

USING IMAGE PROCESSING TO IMPROVE PERCEIVED QUALITY

-  The perceived quality of a product is currently a major issue for consumers, who are increasingly more demanding when it comes to their vehicles.
-  The objective of this project is to improve the vehicle's perceived quality by developing a more reliable means of assembling the body parts while reducing the time taken to position them.
-  SEGULA has come up with a solution for estimating and adjusting play between parts, based on image processing with a camera installed at the assembly station.
-  A non-invasive solution, suitable for all types of components, reliable under industrial use (assembly plant), fast calculation and more precise positioning.



Project leader:
SEGULA
Technologies



Partner:
IVECO Bus



Competencies:
Image processing



Industry 4.0



Advanced tools and methods



Data engineering

SMARI

DIGITALISATION OF INDUSTRIAL PLANTS AND OBJECT RECOGNITION



The construction of reliable and complete 3D digital models of industrial plants is indispensable for reverse engineering and the evolution of existing plants towards Industry 4.0.



SMARI's objective is to create a Mobile Information Acquisition and Recognition System for the modelling of complex industrial installations for monitoring and inspection purposes, and to meet any redesign or optimisation needs that may arise.



SEGULA Technologies develops methodologies for processing point clouds and images obtained from lasergrammetry or photogrammetry. Acquisition and modelling will be carried out in a semi-automatic manner. For this purpose, complex object recognition techniques are being developed.



Digitisation of industrial installations in complete safety (minimisation of risks linked to human intervention on the installations). Speed of reconstruction of a 3D model that can be used with current engineering tools, high-performance for making digital twins.



Project leader:
SEGULA
Technologies



Partner:
Lab-STICC





Competencies:
Scanning, 3D Scan, AI,
Object Recognition


⚙️ Advanced tools and methods


CONSOTRUCK

ARTIFICES UNDER TRAILER

- 

In a context of reducing greenhouse gas emissions, it is necessary to act on all the levers to reduce the consumption of heavy goods vehicles. At a speed of around 85 km/h, more than 40% of the vehicle's power is used to counteract the effect of the air.
- 

Elaborate a CFD model to test different solutions to reduce the drag force and therefore the consumption of trucks.
- 

The trailing force is 75% due to the trailer, 50% of which is at the underframe and rear of the trailer. SEGULA has designed aerodynamic devices in the underframe to direct the air flow onto the wall and thus reduce the wake at the rear of the vehicle.
- 


Reduction in fuel consumption estimated at 2.6% thanks to the proposed fireworks.



Project leader:
SEGULA
Technologies







Competencies:
Design,
Numerical computation in fluid mechanics

 Advanced tools and methods

ANAXAGORE

ANAXAGORE →

REDUCTION OF DESIGN TIMES FOR COMPLEX SYSTEMS

-  Control-command systems are becoming increasingly complex and require trades which all have specific tools, creating risks of errors and vulnerabilities that are often not identified until the end of development.
-  ANAXAGORE's goal is to provide automated gateways between design models to quickly achieve reliable solutions.
-  SEGULA Technologies has developed software that uses the Physical System Model (P&ID) to generate a complex control-command system ranging from commands sent to actuators to the supervision HMI. During the design process, ANAXAGORE enables the integration of ergonomic criteria of HMIs, formal verification and simulation techniques to check the safety of the designed system, and Data Mining technologies to detect cybersecurity issues.
-  Reliable exchanges between experts through a standardised language between the different tools, shortens design times and facilitates the supervision of complex systems.



Project leader:
SEGULA
Technologies



Partners:
Lab-STICC, CRPCC,
LIAS, CRISTAL, IRISA,
Polytech St-Nazaire,
ENSM



Competencies:
IT, Automation, Ergonomics,
Data Mining, Cyber-security

⚙️ Advanced tools and methods

SADENav

DECISION SUPPORT SYSTEM FOR SHIP FITTING OUT

- ❓ Ship fitting out is complex and relies on the know-how of trade experts. The constraints to be taken into account are numerous and varied.
- 🔄 The SADENav project is based on the development of a decision support tool which offers experts a specific fitting out solution for each ship study. This tool also has a learning capacity, in order to propose ever more relevant solutions.
- 💡 SADENav is based on the Virtual Reality technique, through the digitisation and 3D visualisation of premises and objects. The constitution of digital twins allows a collaborative and simultaneous work to the numerous trades. Its learning ability enriches the system as it is used.
- 👍 SADENav allows the expert to be immersed in a 3D digital environment, and real time collaborative working between the involved trades.



Project leader:
SEGULA
Technologies



Partners:
AAU Research
Laboratory, Ecole
Centrale de Nantes



Competencies:
Ship fitting, Virtual Reality, Human-Machine Interaction,
3D Modeling and Digitisation, Interactive Object Placement,
3D Visualisation

⚙️ Advanced tools and methods

THERMICAB



OPTIMISED THERMAL MANAGEMENT FOR ELECTRIFIED VEHICLES

- ❓ Electrified vehicles need to increase their autonomy in order to become a viable solution for the transport of goods and for personal use. To do this, the strategy chosen consists of reducing the energy consumption of the organs involved in thermal comfort to the “minimum necessary” level.
- ⌚ The objective of this project is to develop a virtual demonstrator (digital air conditioning system pre-sizing tool) allowing to obtain savings of at least 10% of autonomy for electrified vehicles.
- 💡 SEGULA has designed a pre-dimensioning software called *Thermicab* capable of predicting the energy requirements necessary to achieve optimum thermal comfort within a vehicle interior. The teams have thus developed a reduced model of a passenger compartment with all its interactions directly integrated into a multi-physical environment.
- 👍 Weight saving, space saving, reduced consumption.



Project leader:
SEGULA
Technologies



Partners:
CETHIL, Fraunhofer
Institut EMI, GreenIng,
Hochschule Esslingen,
IFPEN, LAGEP,
TheSys, SJI



Competencies:
Thermal and thermodynamic calculation,
Numerical modelling

⚙️ Advanced tools and methods 🔥 Environment

ECOBATI



REDUCING THE ENERGY CONSUMPTION OF A BUILDING THANKS TO DIGITAL SIMULATION

- ❓ Between heating and ventilation systems, buildings account for more than 40% of energy consumption in France.
- 🔄 The aim is to optimise the energy consumption of buildings by adapting heating and ventilation according to external conditions and the occupancy of the premises.
- 💡 The solution consists in monitoring the evolution of the energy supply in a building according to weather conditions and occupancy over the course of a day, thanks to CFD simulation. Complex physical phenomena with different time scales are taken into account.
- 👍 Reduction of energy consumption and therefore lower associated costs.
Possibility of deploying the approach to all buildings.



Project leader:
SEGULA
Technologies







Competencies:
Design,
Numerical computation in fluid mechanics

 Advanced tools and methods

SAFE SCOOT



IMPROVEMENT OF THE SAFETY OF TWO-WHEELED VEHICLES

-  According to the French National Interministerial Monitoring Centre for Road Safety, two-wheeled vehicles represent only 1.9% of total motor vehicle traffic, but account for 43% of serious injuries.
-  The SAFE SCOOT project aims to develop solutions to improve the safety of motorcyclists by protecting their vital organs.
-  SEGULA has developed a digital model that incorporates crash scenarios while adhering to EuroNCAP criteria. Analysing these scenarios allows us to design solutions to dissipate energy during side impacts (by deforming the structure). It also provides solutions that allow the driver to speed up to escape the impacting vehicle.
-  A digital crash model suitable for two-wheeled vehicles.



Project leader:
SEGULA
Technologies



Competencies:
Structure calculation,
Crash simulation, Certification

⚙️ Advanced tools and methods

👤 Weight reduction / New materials

FEH HLE

FORMING OF HIGH ELASTIC LIMIT SHEET METAL TO LIGHTEN VEHICLES



The lightening of vehicles can be achieved by using high elastic limit steels. This allows the sheet thickness to be halved compared to standard steel.

However, the forming of this type of steel requires high-speed forming methods that are still not well known, such as electro-hydraulic forming.



The aim is to digitally simulate the manufacturing process in order to have a better knowledge and control of it.



The digital modelling of the electro-hydraulic forming process integrates the formation of the plasma channel in water. Its very rapid extension generates a high velocity shock wave, which hits the sheet metal to shape it.



Reduce the number of physical tests to obtain the final product and thus reduce the time for developing and producing moulds.

Reduce prototyping costs for parts obtained by electro-hydraulic forming for high elastic limit steel parts.



Project leader:
SEGULA
Technologies







Competencies :
Digital simulation in rapid dynamic.

 Advanced tools and methods

FISA



3D CORNER CRACK PROPAGATION IN RESIDUAL STRESS FIELD

-  In aeronautics field, an important problematic is the improvement of the fatigue life of structures, for the design and the in-service maintenance.
-  The aim of the study is to assist operator in making decision about Cold-Working process in presence of crack in holed structures. It's simulate effect of Cold-Working/Interference on different configurations: Open-Hole or Pin-Loaded Hole.
-  SEGULA Technologies has developed a digital model to give the operator a robust implementation of the model with an automatic interaction and a parameterization of the wanted analyses.
-  Provision of a predictive model, increased aircraft life, increased safety.



Project leader:
SEGULA
Technologies



Partner:
AIRBUS







Competencies:
Aeronautics, Numerical modelling,
XFEM

 Advanced tools and methods

INNOVATIVE THERMAL MANAGEMENT

COMPLETE THERMAL MANAGEMENT TOOL

-  With the awareness of the limited resources available and the considerable increase in CO2 emissions and related environmental problems, "clean" vehicles should assert themselves as the means of transport of tomorrow. The challenge is therefore to reduce the energy consumption of vehicles to what is "just necessary". This is possible thanks to optimised thermal management.
-  The objective of the Innovative Thermal Management project is to develop a complete tool to simulate and optimise the thermal management of all types of vehicles and architectures.
-  By taking into consideration the vehicle architecture, the materials used, the climatic conditions and the phases of use, SEGULA has developed a comprehensive tool that makes it possible to perfect the thermal management of vehicles without any architectural limitations. All this while ensuring the best possible passenger thermal comfort.
-  Increased autonomy, an adaptable and predictive tool, reduced energy consumption and thermal comfort.



Project leader:
SEGULA
Technologies



Competencies:
Thermodynamic calculation,
Numerical modelling

🔍 Data engineering

SAFE ROBOTS



INTER-ROBOT DYNAMIC SIMULATION BY ARTIFICIAL INTELLIGENCE

- ?

To date, robotic simulation is carried out using software that does not allow us to determine possible collisions between robotic arms launched dynamically. In addition to the risk of damaging the robots, this represents a waste of time on the development of production tools.
- 🔄

The aim of this project is to determine the optimal trajectories of the robotic arms, and thus reduce the risk of inter-robot collisions during they are started up.
- 💡

The work carried out uses artificial intelligence to automate the search for optimal trajectories. The controller of the robotic arm simulates a trajectory which is progressively optimised thanks to reinforcement learning.
- 👍

The optimisation, which is currently carried out manually, is fully automated using this method, which saves considerable time while eliminating man-made calculation errors. This solution, which can easily be transferred to other sectors, reduces material damage during the actual test phases and reduces the development phases.




Project leader:
SEGULA
Technologies





Competencies:
Artificial Intelligence,
Robotics




SOLID HYDROGEN STORAGE BY COLD PLASMA PROCESS

- 

Hydrogen is a clean energy vector. When used in engine or fuel cell the only byproduct from combustion or redox is water. Gaseous hydrogen storage remains a challenge due to its volumetric mass, flammability and blasting ability.
- 

New possibilities for storage in solid form are emerging, particularly in the form of metal hydrides. They have clear advantages such as a high density of energy storage (higher than in liquid form) and increased safety.
- 

The **HYDROSOL** project aims to study the contribution of cold plasma process in hydrogen storage in metal hydrides. The selected material is a nanostructured intermetallic compound. The nanostructuration boost the plasma-material interaction and thereby enhance the hydrogen concentration inside of the material due to its high surface area.
- 

Development of an innovative material by a brand new process leading to higher storage capacity.



Project leader:
SEGULA
Technologies



Partners:
IITODYS /LIED/LSPM



Planning:
2019-2022



Competencies:
Materials chemistry,
Plasma

⚙️ Advanced tools and methods

TOLDO

TOLERANCE TO IMPACT DAMAGE OF A COMPOSITE LAMINATE



Laminated composite materials are sometimes exposed to external mechanical impacts, which can significantly change their structure and reduce their resistance.



The TOLDO project (TOLDO - TOLDO Impact Density Tolerance of a Composite Laminate) aims to simulate the behaviour of hybrid carbon/glass composite structures after an impact such as a falling tool or a bird strike.



SEGULA Technologies has developed a digital model to simulate the damage caused by an impact. This model has been validated through experimentation. Technological solutions have thus been developed to improve damage tolerance.



Provision of a predictive numerical model, increase in the life span of materials, increased security.



Project leader:
SEGULA
Technologies



Partners:
ISAE, ICA, AIRBUS,
CNRS, ARIANE Group



Competencies:
Aeronautics, Laminates,
Numerical modelling, Impacts

🔍 Data engineering

⚙️ Advanced tools and methods

COMMANDO

SYNTHESIS OF ADVANCED CONTROL LAWS FOR THE CONTROL OF SWARMING UAVS



Site inspection, maintenance or surveillance operations can be simplified and optimised through the use of UAVs (pollution detection, intrusion detection, mapping, etc.).

The use of UAVs in swarms increases the performance of operations but comes up against the complexity of implementation and real-time management.



In order to optimise the flight performance of UAVs in formation or swarm, it is necessary to develop, for each UAV, control laws that enable them to perform their tasks (trajectory tracking, target tracking, positioning, etc.) efficiently in terms of speed and precision. The main obstacle to the development of these control laws is the complex (multi-variable) and non-linear dynamics of UAVs.



The COMMANDO project proposes to use observers to follow the swarm.

The locations provided by these observers are integrated into control laws to optimise the navigation of the swarm.



Optimised management of a swarm of UAVs (precision and speed). Improvement of the control integration when faced with black box models. Reduction in the number of sensors required for the precise location of each UAV.



Project leader:
SEGULA
Technologies



Partners:
IRSEEM / ESIGELEC



Planning:
2019-2020



Competencies:
Electronic systems,
Data processing,
Ordering laws

 Advanced tools and methods

MTCSIM

A SIMULATION TOOL FOR ENERGY CHAIN SIZING



Engine development, energy management and component sizing all require a multitude of calculations and simulation during their design phases.



The MTCSim (Mathematical Temporal Calculation Simulation) project aims to develop an economic tool allowing in particular the simulation of electric and hybrid powertrains vehicles. It was produced independently of market tools. In addition, MTCSim offers the possibility of finely configuring the mathematical models specific to each organ.



SEGULA Technologies has developed an integrated and modular digital simulation platform based on physical models of systems, subsystems and components.




The implementation of the software platform and the mastery of knowledge related to the field of digital simulation allows good reliability and the possibility of upgrading the tool at a lower cost compared to market tools.



Project leader:
SEGULA
Technologies







Competencies:
Energy modelling,
Electrotechnics

 Bio-engineering

WalkCare



AUTONOMOUS PERSONAL ASSISTANCE ROBOT

-  The Silver Economy must respond to the challenges generated by the increase in dependency linked to the ageing of our populations.
-  The objective of this project is to help the elderly to move safely while giving them more independence in their movement. This within the establishment where they reside.
-  In collaboration with Novéup start-up, SEGULA has developed an intelligent autonomous robot called WalkCare. Its robotic performances allow the location of users, the monitoring of their health data and the prevention of falls.
-  Independence of users
Enhanced security when moving around
Better patient follow-up



Project leader:
SEGULA
Technologies



Partner:
Novéup



Competencies:
Robotics, embedded systems,
system architecture, design, HMI,
electronics

 Bio-engineering

 Weight reduction / New materials

I3D-ARTERE

 **PATENT**



Project leader:
SEGULA
Technologies



Partners:
Platform 3d.FAB,
Lyon1 University



Planning:
2018-2021



Competencies:
Polymer additive manufacturing,
Controlled polymer degradation,
Cell regeneration, bioengineering

3D POLYMER PRINTING OF ARTERIAL SUBSTITUTES



Cardiovascular disease is the leading cause of death worldwide and the need for vascular substitutes is constantly increasing due to the low number of healthy donors.



The aim of the I3D-ARTERE is to produce polymer vascular substitute implantable in the human body using additive manufacturing technology, capable of withstanding variations in blood flow pressure, while adapting to the morphology and both mechanical and biological properties of the patient.



SEGULA Technologies, with the help of its partner 3d.FAB, has designed a novel method and custom-made biomaterials. This solution provides the possibility to meet the needs of each patient efficiently and rapidly thanks to the controlled degradation of polymers and simultaneous cellular regrowth.



Repair of diseased arteries with the regrowth of a healthy artery adapted to the specific morphology of the patient, without rejection of the patient.

 Bio-engineering

RENOVALVE



OPTIMISATION OF AN INNOVATIVE CARDIAC IMPLANT USING DIGITAL SIMULATION



The mitral valve located between the atrium and the ventricle of the left heart can present pathologies leading to regurgitation or leakage upon closure and a high mortality risk for patients over 65 years of age. The effectiveness of existing repair devices is insufficient. A new percutaneous repair implant will allow patients to be treated with a minimally invasive surgical technique. SEGULA is working with the BMBI laboratory at the UTC to develop this innovative implant device.



The project focuses on the development of a numerical methodology to model the dynamics of a mitral valve and to predict its behaviour in healthy and pathological cases. The objective is to model the effect of the positioning of the repair implant and to measure its performance on the functioning valve.



SEGULA Technologies has developed a parametric geometric modelling technique for the mitral valve that allows the model to be adapted to each patient and implemented in the calculation software. The numerical simulation of the fluid/structure interaction of the pathological mitral valve with its repair allows the effectiveness of the new device to be evaluated.



To have a digital simulation tool that can be customised to each patient, allowing the design of the implant to be optimised and its functioning to be validated with regard to biomedical standards.



Project leader:
UTC BMBI
Laboratory




Partners:
SATT Lutech
Hospital Henri Mondor
SEGULA Technologies





Competencies:
Numerical fluid/structure simulation




DETECTION OF TRAUMAS DUE TO A ROAD ACCIDENT THANKS TO DIGITAL SIMULATION

- 

Following a road accident, some traumas are not immediately detected by an external examination. They can occur later and worsen over time, leading in the worst case to fatal pathologies.
- 

The THORAX project enables the generation of a simulation of what happens in the human body by taking into account the conditions of the accident.
- 

SEGULA is developing a complete digital model of organ movements in the thorax and of possible damage in order to detect non-visible traumas.
- 


Anticipation of injuries that could occur in a car accident.
Faster patient management thanks to a better understanding of internal and non-visible injuries.
Reduction of tests to diagnose injuries and therefore lower associated costs.



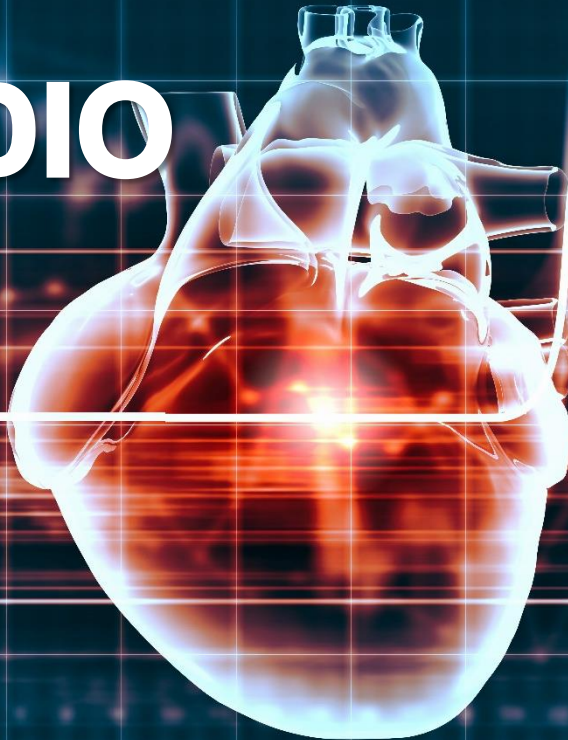
Project leader:
SEGULA
Technologies







Competencies:
Digital simulation,
Rapid dynamic,
Materials

 Bio-engineering

CARDIO



PRODUCT / PROCESS ENGINEERING FOR HEALTH

-  Cardiovascular diseases are the leading cause of death worldwide. The development of an aortic aneurysm is virtually symptomless and its rupture is almost always fatal.
-  The aim of this project is to develop training systems to enable professionals to practice before surgery.
-  SEGULA develops reproductions of healthy or pathological organs, morphologically faithful to the cardiovascular system. They are designed mainly in plastic materials (flexible and rigid), compatible with medical imaging, through rapid manufacturing (prototyping, machining or 3D printing). They are then proposed as kits to the medical profession for training in the fitting of stents, endoprostheses, etc.
-  Reduction of the duration of interventions and related risks. Improvement of the efficiency of surgical operations. Minimise the risk of death from cardiovascular disease (aneurysms, aortic dissections, etc.).



Project leader:
SEGULA
Technologies



Partners:
Hôpitaux civils de Lyon



Competencies:
Materials,
Digital reconstruction,
Prototyping



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A COLLABORATIVE, AUTONOMOUS
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DIGITALISATION OF INDUSTRIAL
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12 **E3S**
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RIVER SOLUTION THE CLEAN URBAN
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USING COMPOSITES TO PRODUCE A
30% LIGHTER TRUCK CAB

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A TRUCK THAT ADAPTS TO ITS
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REDUCING THE ENERGY
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CALCULATOR

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A SIMULATION TOOL FOR
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Weight reduction / New materials

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USING COMPOSITES TO PRODUCE
A 30% LIGHTER TRUCK CAB

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A TRUCK THAT ADAPTS TO ITS
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