WHAT IS THE CORRELATION BETWEEN FATIGUE AND BLOOD ANTIOXIDANT LEVELS? HOW CAN MEASURING THEM HELP ENHANCE TRAINING?

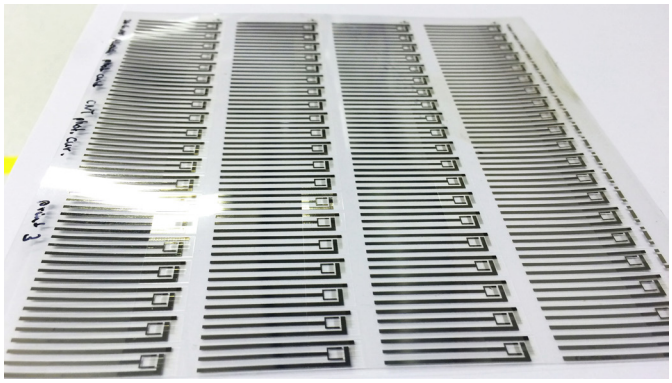
O2SCORE: OPTIMIZING TRAINING

When we engage in a physical effort, the production of free radicals increases and, depending on our recovery rate, antioxidant production also increases to eliminate them. These changes can be used to manage recovery, combat fatigue, optimize training, manage recovery and increase performance.

How fast is an athlete recovering after physical effort? The system developed by O2Score makes it possible to measure blood antioxidant levels in a rapid and practical way, helping athletes manage their training and recovery in order to reduce the risk of injuries and to improve their performance.

During sports training, the consumption of oxygen increases and triggers a series of biological reactions. To determine whether the body has been overworked during training, EPFL's Laboratory of Physical and Analytical Electrochemistry (LEPA) has developed electrodes and an analysis system that can measure the level of the systemic antioxidant defense system in a drop of blood. The electrodes are produced by printing carbon nanotubes, and the speed of measurement means that the system is particularly well suited to the repeated measurements required to manage training and recovery more effectively.

The system is already used by competitive athletes, and studies are under way to develop the most suitable usage protocols and to apply the approach to other related areas, including nutrition and the control of stress and anxiety.



Electrodes.

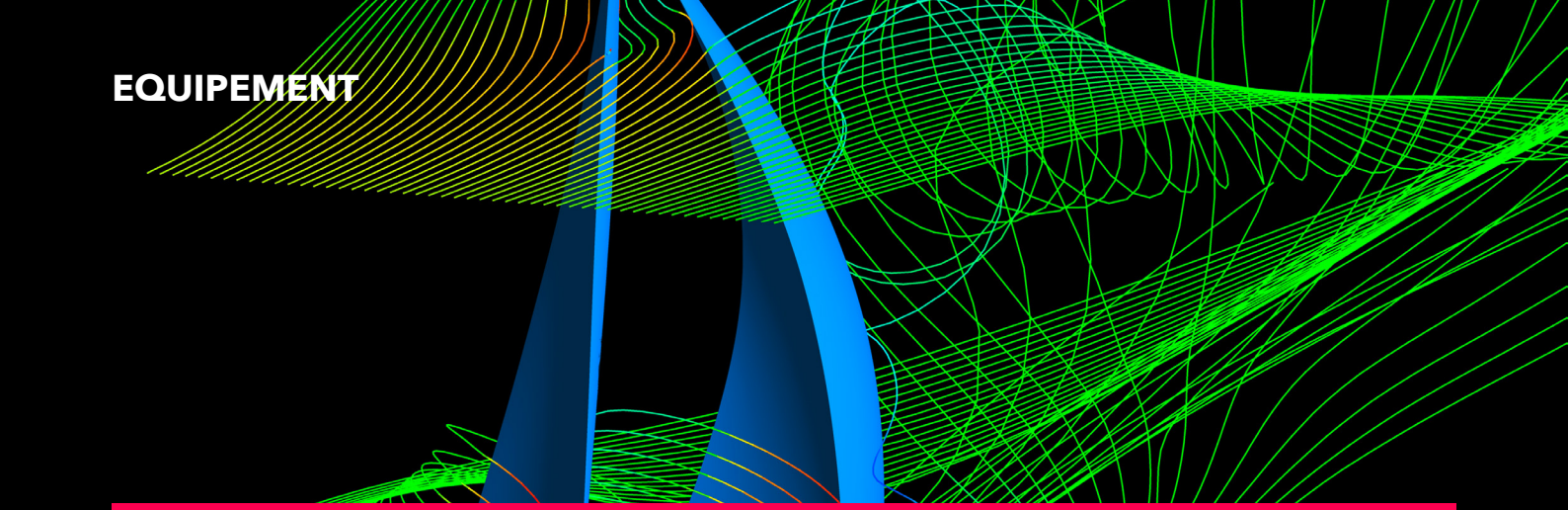
Switzerland's coxless four team, which finished in the top eight in the Rio 2016 Olympics: O2Score users.

First-division team in France: O2Score users.

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Development and production of electrodes - Blood analysis
Laboratory of Physical and Analytical Electrochemistry (LEPA)
Prof. Hubert Girault – lepa.epfl.ch

SCORE 2
Startup spun out of the laboratory



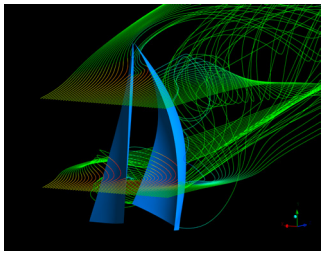
DEVELOPING A DIGITAL MODELING TOOL TO OPTIMIZE PERFORMANCE BY TESTING DIFFERENT GEOMETRIES

COMPUTATIONAL FLUID AND STRUCTURAL DYNAMICS (CFSD)

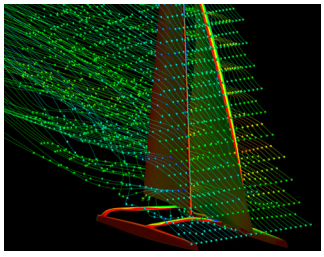
How do wind and waves influence the performance of a boat? How can a cyclist's position be optimized to reduce wind resistance?

Until recently, the most effective way of testing how a piece of equipment performed was by putting it in a realistic situation, such as a wind tunnel or a towing tank. Today, cheaper digital methods are used to model aerodynamics and hydrodynamics. The Computational Fluid and Structural Dynamics (CFSD) laboratory take a mathematical approach to the matter. It is able to simulate a wide range of flows using a mathematical model of the object, factoring in the way it deforms and moves.

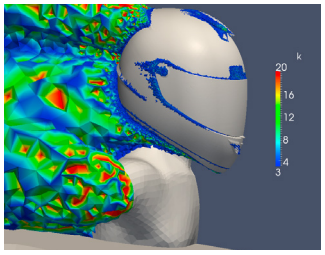
EPFL's Chair of Modeling and Scientific Computing (CMCS), in conjunction with the mathematics department of the Politecnico di Milano, is working to refine this approach. Researchers are studying and developing new approaches allowing them to test, with limited calculation resources, a maximum number of geometries in a short space of time so that engineers can choose the most suitable solution for their problem.



Air flows around the sails of Alinghi AC32.

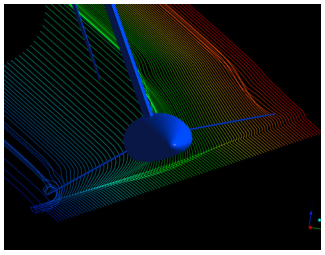


Air flows around the Alinghi AC33 catamaran and pressure on the sails and hull.

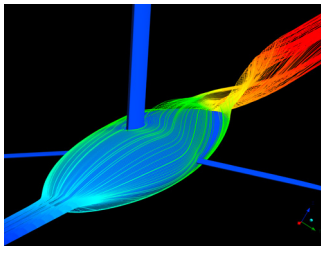


Turbulence kinetic energy behind a MotoGP competition helmet (M0X0FF).

Waves generated by the hull of a coxed eight boat.



Turbulence around the appendages of the Alinghi AC32.



Current lines around the bulb of the Alinghi AC32.

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Digital simulation
Chair of Modeling and Scientific Computing (CMCS)
Prof. Alfio Quarteroni– cmcs.epfl.ch

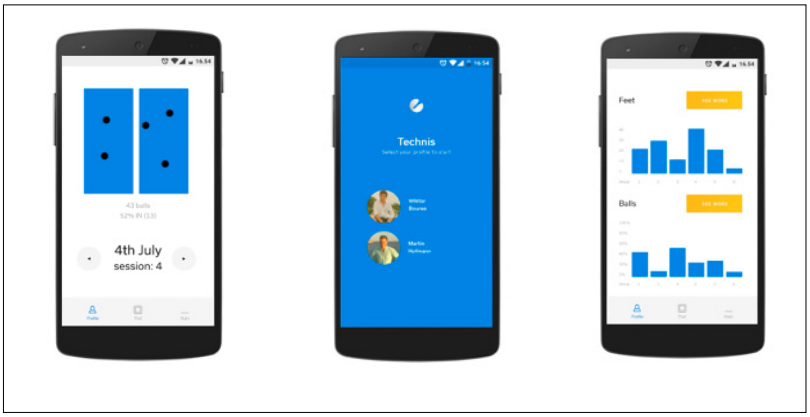
In partnership with
POLITECNICO MILANO 1863
Digital simulation

ENHANCING TENNIS PERFORMANCE USING A SPECIAL SURFACE THAT TRACKS BALL IMPACTS AND PLAYER REACTION TIMES

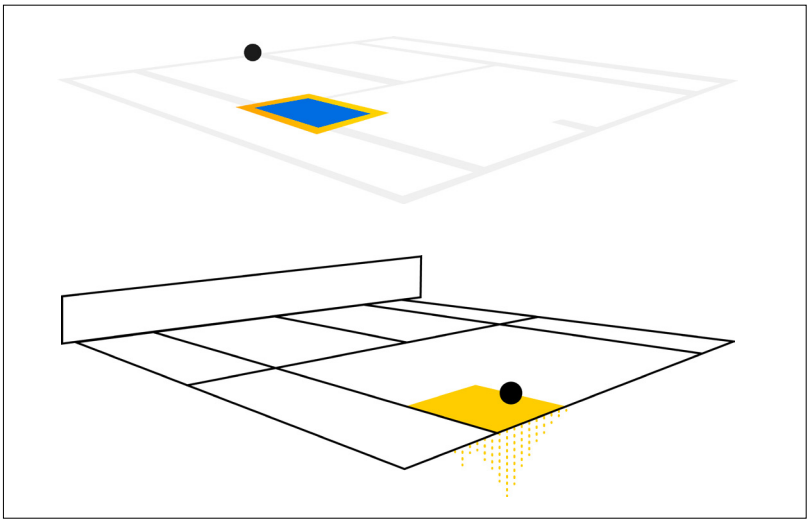
TECHNIS, A SMART TENNIS COURT SURFACE

How can the effectiveness of a tennis shot be measured? How can a player raise performance levels and cut reaction times? The Technis project is a smart court surface that detects physical contact and provides feedback not only about ball impacts, but also about the athlete's speed of reaction.

The surface was designed by Technis, a startup supported by the Laboratory for Photonic Materials and Characterization (LPMAT) with funding from Innogrant. It incorporates a mesh of piezoelectric fibers able to detect physical contact.
Machine-learning algorithms and techniques allow the system to fine-tune its measurements and analysis during use. It can be applied anywhere and is water-resistant, providing an alternative to conventional training. The precise location of impacts, ball speed and player movement stats can be used to analyze performance during training. Data can be visualized using an application, which maps out the various shots played. The system presents an all-round picture of players' performance in a fun way, helping players to improve the technical side of their game.



Technis application for tracking improvements.



Areas equipped with sensors to determine the quality of the player's movements and stroke accuracy.

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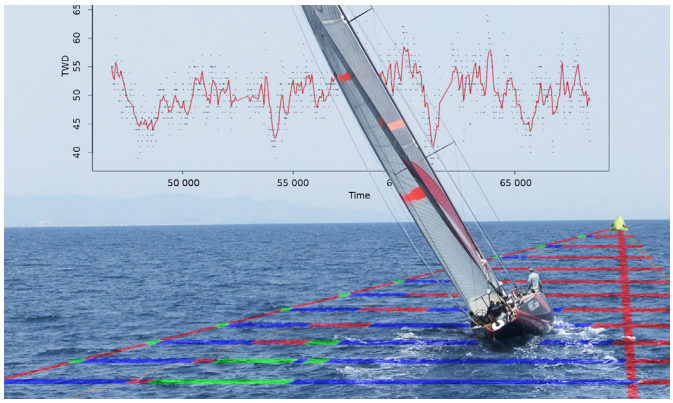
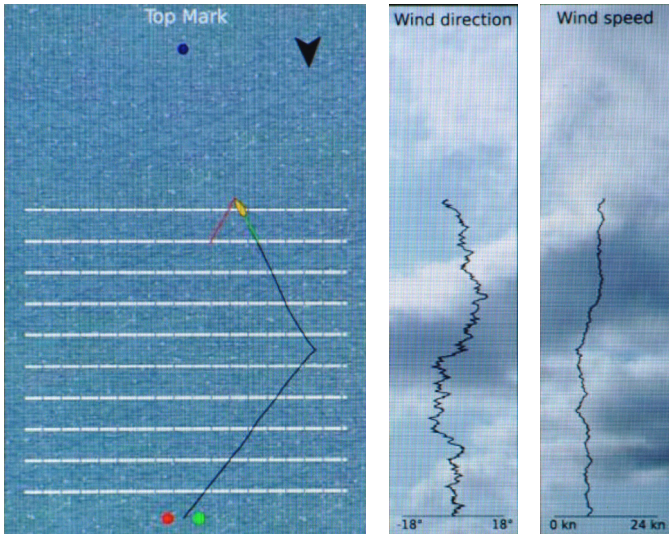
Piezoelectric fibers
Laboratory for Photonic Materials and Characterization (LPMAT)
Prof. Gian-Luca Bona – lpmat.epfl.ch

Technis
Startup associated with the laboratory

DATA ANALYSIS

USING MATHEMATICS TO GAIN INSIGHTS FROM DATA





Trajectory simulation system based on changes in the wind.

STATISTICAL DATA PROCESSING

What are the most effective strategies for addressing unpredictable challenges? What are a team's strengths and weaknesses? How should you react in a particular situation to maximize your chances of ultimate success? What are a given team or player's chances of success?

Developments in new measurement technologies and the growing use of sensors in sports have created huge volumes of data. The problem for athletes and their coaches is how best to analyze this wealth of information and pick out the salient points to make the right decisions. The statistical approaches and the knowledge acquired by EPFL's Chair of Applied Statistics (STAP) can be used to extract meaning from raw data. Probability calculations can validate the quality of the information obtained, compare various game strategies and determine which is the best.

Under the partnership with Alinghi and the Chair of Probabilities (PROB), projects have addressed the issue of how to deal with the unpredictability of wind, drawing in particular on meteorological data. Another project has studied the on-court positioning of volleyball players. Statistical approaches provide an essential tool for handling the proliferation of data available and can turn raw data into valuable insights. The mathematical formulation of the problem at hand yields probabilistic methods and tools, which can be incorporated into software to automate analytical tasks. The end result consists of specific indicators that can be interpreted by athletes and coaches.

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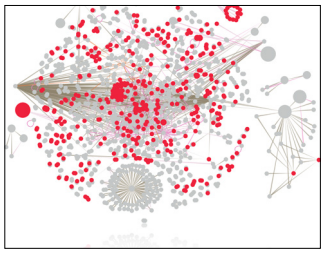
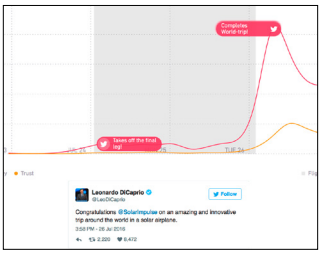
Probability and Statistics
Chair of Applied Statistics (STAP)
Prof. Stephan Morgenthaler – stap.epfl.ch
Chair of Probabilities (PROB)
Prof. Robert Dalang – prob.epfl.ch

ALGORITHMS FOR TRACKING AND ANALYZING EMOTIONS, OPINIONS AND VIEWS EXCHANGED ON SOCIAL MEDIA



Brexit: a chart showing the positions of both sides of the debate on social media and interconnections between key influencers.



Real-time tracking of the general public's emotions about the Solar Impulse project. Here, the explosion of joy at the end of its round-the-world flight in Abu Dhabi is evident.

Spectator sending a message at a game.

Messages sent by the public.

HORIZON, A TOOL FOR ANALYZING SOCIAL MEDIA CONVERSATIONS

How can we gain insight into the emotions, opinions and views expressed through the countless discussions and data exchanged on social media?

Sports generate a great deal of excitement and build strong engagement, resulting in a large volume of social media and web traffic. EPFL's Social Media Lab (ESML) is working on algorithms and a platform that can identify the various opinions present on the web and on social media. Horizon can provide a graphical representation of hot topics and pinpoint the most influential sources concerning a specific subject, such as a sports event.

This approach can provide a deeper understanding of an event's audience so that the right communication strategy can be adopted. It is also possible to:

- understand public opinion about a particular event
- measure the success of an event
- identify improvements
- characterize the general public's feelings
- identify emerging hot topics and track how they develop

In a world first, the Horizon platform has already proven its worth in analyzing events such as the Solar Impulse circumnavigation and the COP21 Climate Change Conference in 2015. It provides unique real-time insight into public opinion about events generating interest on the web.

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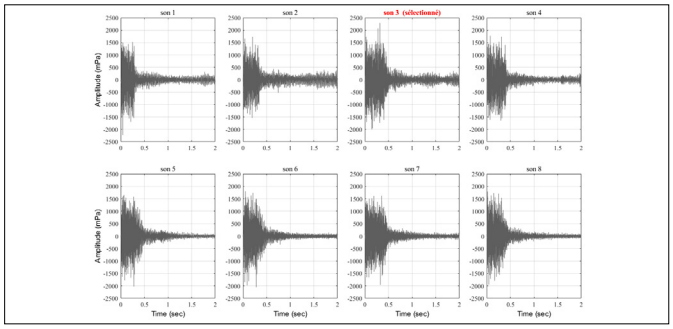
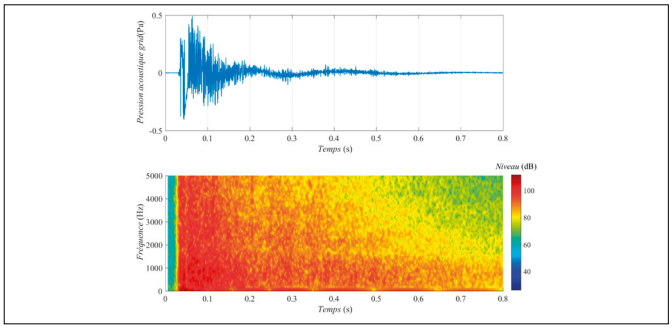
Development of text analysis algorithms
Social Media Lab (ESML)
Jean-Luc Jaquier – socialmedialab.epfl.ch

REPLACING THE TRADITIONAL STARTER'S GUN WITH A STARTING SIGNAL THAT MEETS THE ATHLETES' NEEDS AND DOES NOT CHANGE THE SPECTATORS' EXPERIENCE



Recordings of 8 sounds created and broadcast at the Pontaise stadium using the electronic pistol system.



Recording of an actual starter gun and spectogram (time, frequency and sound level analysis) of the sound.

ELECTRONIC START SIGNALS THAT MIMIC THE SOUND OF THE STARTING GUN

Officials at track meets are no longer able to use conventional starter guns. For security reasons, they have been replaced with electronic pistols. The audio output needs to be optimized to make sure that it corresponds to what the athletes are expecting, and that the spectator experience is not impaired.

The Signal Processing Laboratory 2 (LTS2) specializes in both acoustic signal processing and loudspeaker and microphone design. Sound signals are created, they propagate and they are heard. Expertise in these three phases of the process is required to come up with solutions for a variety of situations. This includes generating a particular sound using an electronic tool, controlling its propagation – to either attenuate it or ensure that remains audible – or to use the noise to locate an impact.

Swisstiming turned to the LTS2 lab to work on the sound made by electronic starter guns. After firearms restrictions were tightened, alternative starting-signal solutions needed to be found for track meets. In this project, the laboratory's challenge was to replicate the sound of a firearm being discharged as closely as possible in terms of how it is perceived, while making sure it is audible for the competitors and the general public. The laboratory had to work with the existing sound systems, taking into account the properties of the loudspeakers and electronic components to ensure that the signal satisfies the competition guidelines.

The laboratory's broader expertise can be applied to other aspects of sports coverage. For example, it could be used to tone down the crowd noise at an indoor swimming pool, locate the impact of a projectile or enhance rebroadcasts by recording sounds more accurately.

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Isolation, propagation, creation, perception and elimination of acoustic signals

Signal Processing Laboratory 2 (LTS2) Acoustics Group
Dr. Hervé Lissek – lts2.epfl.ch

bidacs Acoustic Technologies

aer Acoustical Engineering & Research

Startups spun out of the laboratory

In partnership with

SWISS TIMING

Organization of the firing competition