idiap
RESEARCH INSTITUTE
THANK YOU
to our colleagues and partners
ANNUAL
REPORT 2020

Scientific staff

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Niccolò Antonello, Postdoctoral Researcher
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THANK

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Suhan Shetty, Research Assistant
Rémy Siegfried, Research Assistant
João Silverio, Postdoctoral Researcher
Prabhu Sivaprasad, Research Assistant
Marco Sousa Ewerton, Postdoctoral Researcher
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Sibo Tong, Research Assistant
Sandrine Tornay, Research Assistant
Cédric Travelletti, Research Assistant
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Colombine Verzat, Research Intern
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Apoorv Vyas, Research Assistant
Lei Wang, Trainee
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Yu Yu, Postdoctoral Researcher
Qingran Zhan, Research Assistant
Juan Pablo Zuluaga Gomez, Research Assistant

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Cyril Bell, Student
Olivier Bornet, Head of R&D Team
Annie Bornet, Student
Rudolf Braun, Junior Developer
Olivier Canévet, Senior R&D Engineer
Daniel Carron, R&D Engineer
Guillaume Clivaz, R&D Engineer
Bastien Crettol, System Administrator
Yannick Dayer, R&D Engineer
Ludmilla Dorsaz, Student
William Droz, R&D Engineer
Oriane Fellay, Student
Gandal Foglia, Student
Nyssa Foglia, Student
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Magali Formaz, Student
Samuel Gaist, Senior R&D Engineer
Theophile Gentilhomme, R&D Engineer
Mélanie Huck, R&D Engineer
Salim Kayal, Senior R&D Engineer
Ragip Limani, Caretaker
Nazifa Limani, Cleaning and Caretaker Assistant
Jérémy Maceiras, R&D Engineer
Christine Marcel, Senior R&D Engineer
Léo Marcel, Student
Manou Maret, Student
Josselin Millius, Student
Zohreh Mostaani, R&D Engineer
Alexandre Nanchen, Senior R&D Engineer
Danick Panchard, R&D Engineer
Louis-Marie Plumel, Senior System Administrator
Vincent Pollet, R&D Engineer
Nazmije Shala, Cleaning and Caretaker Assistant
Vincent Spano, Webmaster
Audrey Sutter, Student
Flavio Tarsetti, Senior R&D Engineer
Laurent Tomas, Senior System Administrator
Jules Voisin, Student

Administrative staff

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Laura Coppey, Administrative Assistant
Justine Darioly, Program Manager
Joel Dumoulin, Technology Transfer Officer
Nicolas Filippov, Communication
François Foglia, Deputy Director
Barbara Huguenin, Program Manager
Marie-Constance Landelle, Legal Adviser
Sylvie Meier, Office & HR Senior Administrator
Pierre Odobez, Master's Student
Daniel Roduit, Student
Aurélie Rosemberg, Visitor
Christophe Rossa, Financial Manager
Nadine Rousseau, Administrative Assistant

THANK YOU

Authorities and founding members

AVEC LE SOUTIEN DE LA VILLE DE MARTIGNY

www.martigny.ch

CANTON DU VALAIS
KANTON WALLIS

www.vs.ch

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'économie, de la formation et de la recherche DEFR
Secrétariat d'Etat à la formation, à la recherche et à l'innovation SEFRI

www.sbfi.admin.ch

Fondation Dalle Molle
Pour la qualité de la vie

www.dallemolle.ch

swisscom

www.swisscom.ch

EPFL

www.epfl.ch

UNIVERSITÉ DE GENÈVE

www.unige.ch

Partners

LOTERIE ROMANDE

www.loro.ch

the ark
www.theark.ch

www.theark.ch

ideark

www.ideark.ch

FNSNF
Fonds national suisse
Schweizerischer Nationalfonds
Fondo nazionale svizzero
Swiss National Science Foundation

www.snf.ch

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation
Innosuisse – Swiss Innovation Agency

www.innosuisse.ch

HASLERSTIFTUNG

www.haslerstiftung.ch

UniDistance.ch

www.unidistance.ch

Special thanks

1 Staff 2020

2 Main partners

Messages

6 “The ambition to do always more for society”

7 “I am proud of Idiap and its values”

Overview

9 Research at the service of the community

10 Idiap, at a glance

Organization

13 Organization chart

14 12 research groups

16 Foundation Council

17 International Advisory Board

Finances

19 Balance sheet

20 Profit and loss statement

21 Accounting analysis 2020

Research

23 Swiss algorithms to help customers of a Finnish shopping mall

24 AI for media: Less fake news, more ethics

25 A smart scooter for improved battery management

26 TV drama *CSI* helping progress toward AI-based investigations

Commitment

29 Graduate in Artificial Intelligence and influencing an entire company

30 A million pictures to check manually

31 Idiap becomes an accredited center for Android

32 How the Swiss fared under partial lockdown

33 Hygiene and cyber precautions, a key challenge for hospitals

Faces

35 “This place has to be welcoming”

36 “We were inspired by Berkeley”

38 Prizes and distinctions

39 Theses completed

Scientific inserts

III Scientific Report

XXV Main projects in progress

XXXIII Publications

→ 22

→ 25

→ 26

→ 31

→ 34

→ 36

Olivier Dumas
President of the Foundation Council

"The ambition to do always more for society"

More than a simple account of the year 2020, this annual report is above all a look into the future. The future of the Institute, but also and above all the future of society. The federal government's decision to expand our budget by almost 60 percent for the next four years heralds an opportunity to maintain our excellence on the global stage but also signals our responsibility—given the trust invested in us—for implementing projects with significant socio-economic benefits. More than ever, technology transfer and multi-disciplinarity are essential prerequisites in the research arena.

Fake news, new modes of interaction, the management of electric vehicles, and safety and hygiene in hospitals—Idiap's research contributes to meeting all these current challenges. These contributions serve as examples of a long-standing approach that illustrates the need to conduct research with a long-term, application-oriented vision. The Institute is committed to meeting the needs of today and those of tomorrow with that vision.

Multi-disciplinarity, then, is one of the main pillars of the new strategy now being implemented at Idiap. Given its diverse fields of application, artificial intelligence has always been in the DNA of the Institute. Today the goal is to strengthen this historic activity, enriching it with transversal research groups specifically dedicated to the development of interdisciplinary research and applications.

As I sign my final "Message from the President," I would like to express my gratitude to the entire staff of Idiap and to the many members of the Foundation Council who have accompanied me on this journey for sixteen years. Appreciative of the support provided by the Swiss Confederation, the authorities of the Canton of Valais, the city of Martigny, and all of Idiap's partners, I am already looking forward to seeing our many engagements for society's benefit bear fruit.

Hervé Bourlard
Director, Idiap; Professor, EPFL

"I am proud of Idiap and its values"

Despite 2020 proving to be a highly unusual year both for our Institute and for those who work in it, we adapted, and took up the challenge of developing an ever-more ambitious growth plan. At the nexus of artificial intelligence, signal processing, and machine learning, we are convinced of our work's increasingly tangible relevance to society.

Every day, artificial intelligence produces numerous tools that improve quality of life, in fields as varied as information processing, security, robotics, health, and privacy. I am proud that Idiap makes such an important contribution to these endeavors.

In addition to our nationally and internationally recognized, award-winning research, we intend to focus on developing innovative technologies in answer to a range of economic and societal concerns. This approach has garnered the support of the authorities and our founding members, starting with the Swiss Confederation, the State of Valais, and the city of Martigny, all of which have made a financial commitment to us for the period 2021–24.

We are now working to make these goals a reality. Since the start of the year, for example, we have hired several new research group heads to strengthen our leadership in our chosen fields of activity. The next step will be to establish transversal groups that will serve as catalysts for the integration of our existing scientific work into our new research visions.

Our commitment to our collective future also touches the Institute itself. And we are thus delighted to have been able to offer the best of our young researchers the opportunity to pursue their careers in Switzerland, at Idiap—either by creating their own working group or via our spin-offs.

My colleagues and I are pleased to share our values with respect to excellence and our optimism with regard to the future in the form of this annual report. We hope that reading it will prove contagious, and will inspire you—and why not—to collaborate with us.

overview

08—11

Research at the service of the community

Jérôme Kämpf
Head of the Energy Informatics group

"The goal is to have, thanks to machine learning, a model that's able to more accurately recognize an electric vehicle driver's style, while respecting her or his anonymity."

Not wasting energy is obviously important when it comes to heating solutions or the management of power grids. But the same is true of electric mobility, and in particular battery management—a vital topic for the energy transition.
→ *More on page 25.*

Nadine Rousseau
Secretary, Idiap

"At Berkeley, we really appreciated how housing and help upon arrival were prepared prior to our stay. That's what we have aimed to recreate at Idiap."

Her attention to the smallest of details has made a difference to many a newcomer or visitor to Idiap. After over 23 years, Nadine looks back at the tremendous growth of the Institute and the human challenges of a unique and multicultural place.
→ *More on page 36.*

Lambert Sonna
CEO of Global ID

"We have already created a device able to scan through a surgical glove; now the goal is to make it contact-less and fast."

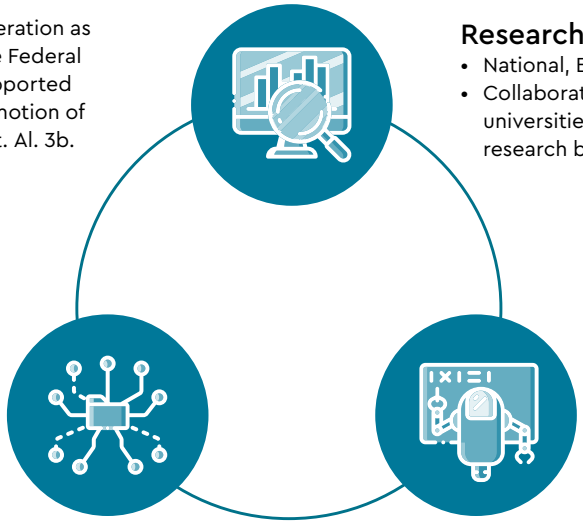
How to reconcile hygiene and security in hospitals? Highly futuristic venous identification is allowing the start-up Global ID to respond to the challenge, with the help of Idiap's biometrics lab.
→ *More on page 33.*

Idiap, at a glance

Idiap's vision is to promote quality of life through scientific progress in the field of artificial intelligence.

3 missions

Idiap is recognized by the Confederation as part of the strategic domain of the Federal Institutes of Technology and is supported under the Federal Law on the Promotion of Research and Innovation (LERI), art. Al. 3b.

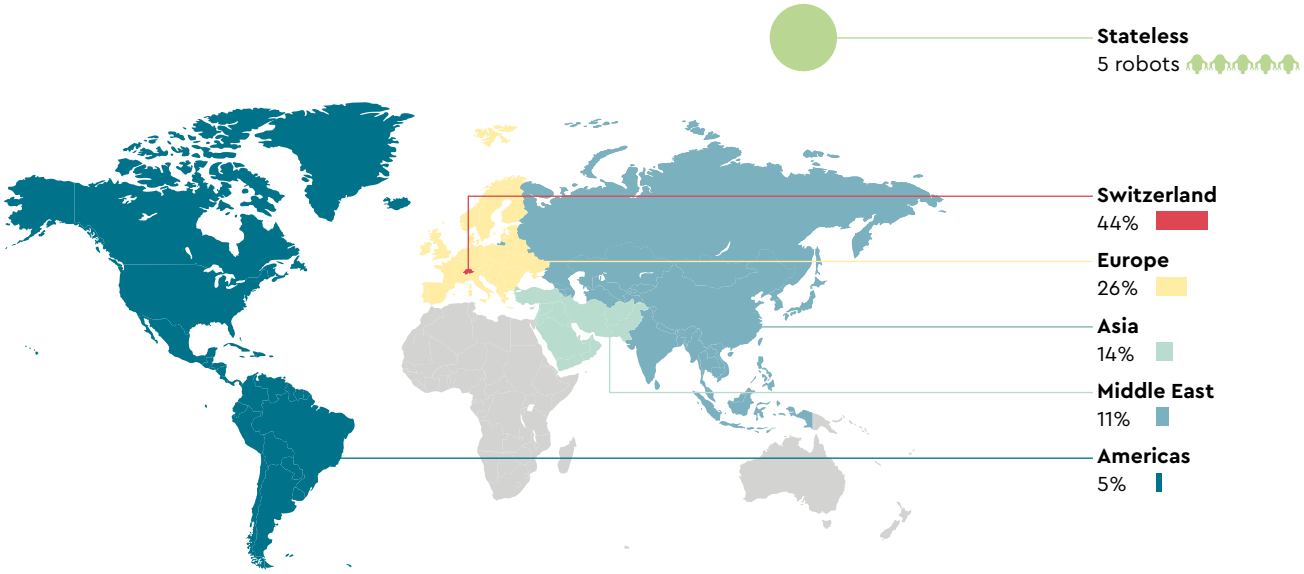


Research
- National, European, and worldwide
- Collaborations with prestigious universities and public and private research bodies

Innovation
- Technology transfer
- Start-up creation
- Dedicated incubator—IdeArk
- Patents, licenses, and open source

Training
- Numerous courses at EPFL and internally
- Master's in Artificial Intelligence incorporating guaranteed work experience
- Encouraging the next generation of young researchers

33 nationalities are represented at Idiap



Human resources

197 individuals in total and more than 50 posts in the start-up ecosystem

Scientific staff

15 permanent professors/ researchers
60 research assistants
24 postdocs
26 trainees/visitors
17 students

16.2% women
83.8% men

Engineers & technical staff

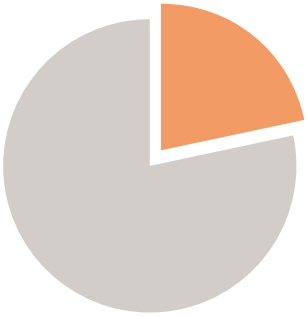
19 R&D engineers
6 system engineers
16 technical assistants/students

29.2% women
70.8% men

Administrative staff

14 administrative staff

57.1% women
42.9% men



21.8% of Idiap employees are women, **78.2%** are men

Publications and patents in 2020

Contributions to 110 peer-review publications

57 conference articles

12 theses completed

41 scientific articles

3 patents recognized

1 patent sold

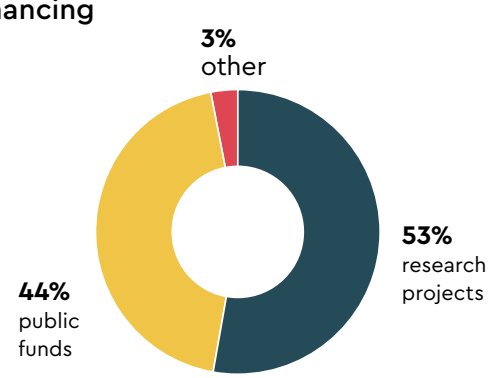
6 further patents filed

4,367 LinkedIn followers ↗ 43% in 2020

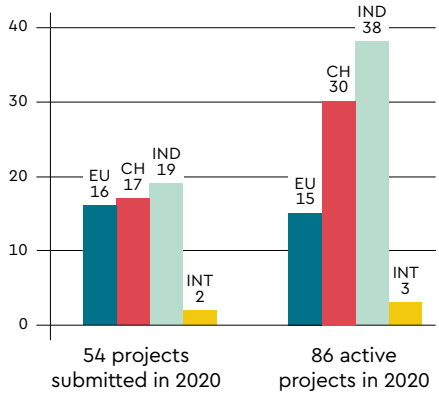
1,599 Twitter followers ↗ 41% in 2020

370 "press clippings"

Financing



Submission and financing of research projects in 2020

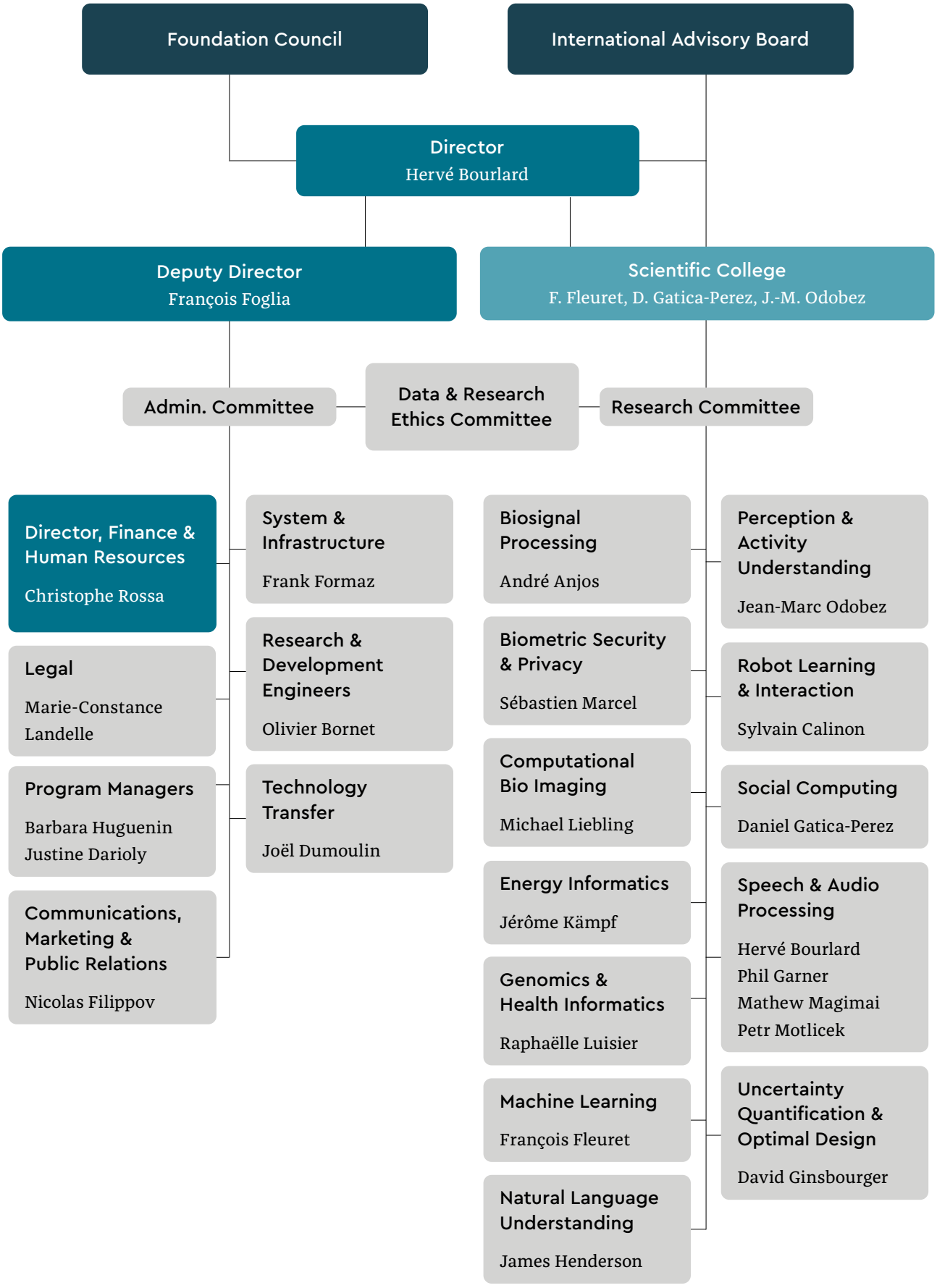


CH: Switzerland EU: European Union IND: Industrial INT: International

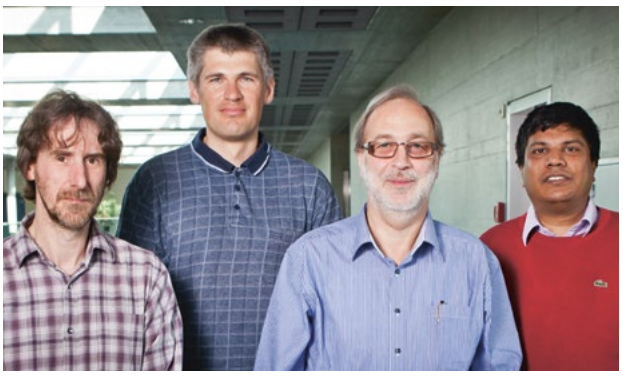
organization

12—17

Organization chart



12 research groups



Speech & Audio Processing

Prof. Hervé Bourlard (third from left),
Dr. Phil Garner, Dr. Petr Motlicek, Dr. Mathew Magimai-Doss
H-indexes: PG: 28, PM: 24, HB: 65, MMD: 30

Speech processing has, for many years, been one of Idiap's major research themes.

Statistical automatic speech recognition; voice synthesis and the generic processing of audio information (source localization; microphone networks; speaker segmentation; information indexing; very-low-bit-rate speech coding; background noise analysis).

Biometric Security & Privacy

Dr. Sébastien Marcel
H-index: 55

The automatic recognition of individuals through the use of behavioral and biological characteristics is the foundation stone of computer biometrics.

Development of image processing and pattern recognition algorithms for face recognition (2D, 3D, and near infrared); speaker recognition; antispoofing; study of emerging biometrics modalities (electrophysiology and veins); open science thanks to our own open source library.

Biosignal Processing

Dr. André Anjos
H-index: 26

The analysis of biomedical sensor data for medical or research purposes lies at the heart of the research carried out by the Biosignal Processing group.

Analysis of e-health data; detection of human biological signals for medical and scientific applications; use of machine learning techniques; data acquisition and analysis; open science.

Computational Bio Imaging

Prof. Michael Liebling
H-index: 24

The technique of computational imaging and biomedical image analysis lies at the heart of the group's imaging research.

Development of algorithms for deconvolution and super-resolution in optical microscopy; three-dimensional tomographic reconstruction; more generally, combination of unusual detection methods and devices with computational software to produce images ideally suited to the observation and quantification of complex, living biological systems.

Energy Informatics

Dr. Jérôme Kämpf
H-index: 26

Information and communication technologies help us to fight climate change and to increase the proportion of renewable energy and the number of distributed energy sources.

Creation of smarter energy systems; global optimization of energy efficiency; scenarios of energy transition including intelligent control and adjustment mechanisms for building retrofitting; production and storage of renewable energies in the context of climate change.

Genomics & Health Informatics

Dr. Raphaëlle Luisier
H-index: 10

Artificial intelligence technologies such as statistics, machine learning, and data visualization could further unlock the potential of genetics for health.

Genomics, bioinformatics, RNA biology, neuroscience, data science, and data visualization, all related to cellular imaging, genomic data, and neurodegenerative diseases, and studied in collaboration with molecular neuroscience and bioengineering experts.

Natural Language Understanding

Dr. James Henderson
H-index: 26

Deep learning models of the syntax and meaning of text are used for machine translation, natural language inference, and summarization.

Neural machine translation; summarization; information retrieval and extraction; text classification; attention-based deep learning models of language understanding; representation learning for modeling abstraction and natural language inference.

Robot Learning & Interaction

Dr. Sylvain Calinon
H-index: 45

Human-centric robotic applications exploit multimodal sensory information and develop intuitive learning interfaces.

Develop statistical approaches for encoding movements and behaviors in robots evolving in unconstrained environments; models with multiple roles (recognition, prediction, reproduction); learning strategies (imitation, emulation, incremental correction, or exploration).

Uncertainty Quantification & Optimal Design

Prof. David Ginsbourger
H-index: 29

Quantifying and reducing uncertainties in the context of high-fidelity models is central to this group's research interests.

Gaussian process methods; the planning of numerical experiments for optimization, inversion, and other related problems. Areas of application include energy and geosciences, with collaborations ranging from safety engineering to hydrology and climate sciences.

Machine Learning

Dr. François Fleuret
H-index: 38

The development of new statistical learning techniques, principally for computer vision, is the basis of the group's work.

Computational properties of statistical learning; automatic image analysis, particularly the automatic extraction of significance; object detection; tracking of people and biological structures.

Perception & Activity Understanding

Dr. Jean-Marc Odobez
H-index: 46

The analysis of human activities from multimodal data is useful for surveillance, behavior analysis, human–robot interfaces, and multimedia content analysis.

Development of algorithms based on computer vision and learning and data fusion methods in order to detect and track objects and people, to represent and characterize their state, and to model sequential data and interpret them in the form of gestures, behaviors, and social relations.

Social Computing

Dr. Daniel Gatica-Perez
H-index: 66

The integration of theories and models from informatics and the social sciences makes it possible to detect, analyze, and interpret human and social behavior.

Behavioral analysis of face-to-face interactions; crowd-sourcing and the large-scale treatment of urban data; smartphones and social networks.

* **The h-Index** attempts to quantify both the productivity and the impact of scientists based on the number of citations that they have received in other publications (citation level). The higher the number, the more the researcher has been cited. H-index as of April 13, 2021 (source: Google Scholar).

Foundation Council

The Foundation Council is responsible for the economic and financial management of Idiap. It defines the Institute's structure, appoints its director, and—more generally—ensures Idiap's development and defends its interests.

Olivier Dumas, President

Independent manager and business consultant

Anne-Laure Couchepin Vouilloz, Vice-President

President of the city of Martigny

Marc-André Berclaz

Valais–Wallis Cluster

Stefan Bumann

Head of the Service des Hautes Ecoles (SHE)

Patrick Furrer

Scientific collaborator at swissuniversities

Jordi Montserrat

Regional Manager Venturelab

Prof. Stéphane Marchand-Maillet

Associate professor at the Department of Computer Science of the University of Geneva

Dominique Perruchoud

President of the Board of Cimark SA

Prof. Pierre Vandergheynst

Professor and Vice-President for Education at EPFL

Dr. Michael Baeriswyl

Executive Vice-President of Data, Analytics & AI, Swisscom

International Advisory Board

The Advisory Board is composed of members of the scientific community selected by Idiap's management for their exceptional skills and avant-garde vision. Although their role is strictly advisory, their support is frequently sought and proves valuable when making decisions regarding research, training, and technology transfer.

Dr. Alex Acero

Senior Director at Apple, Cupertino, CA, USA

Dr. Alessandro Curioni

IBM Fellow, Vice President Europe and Director at IBM Research, Zurich, CH

Prof. Anil K. Jain

Distinguished Professor, Department of Computer Science & Engineering, Michigan State University, USA

Prof. Neil Lawrence

DeepMind Professor of Machine Learning at the University of Cambridge, UK

Dr. Fabienne Marquis Weible

Director of the Swiss Association for Horological Research, Engineer at EPFL, CH

Prof. Klaus-Robert Müller

Professor of Computer Science, TU Berlin; Director, Bernstein Focus on Neurotechnology, Berlin, DE

Prof. Stefan Roth

Professor of Computer Science and Chair of the Department of Computer Science at TU Darmstadt, DE

Prof. Mihaela van der Schaar

John Humphrey Plummer Professor of Machine Learning, Artificial Intelligence and Medicine at the University of Cambridge, UK

Prof. Stefan Wrobel

Professor of Computer Science at the University of Bonn and Director of the Fraunhofer Institute for Intelligent Analysis and Information Systems (IAIS), DE

finances

18—21

Balance sheet (CHF)

ASSETS	31.12.2020	31.12.2019
Cash	**6 221 594**	7 511 323
Accounts receivable	**606 226**	104 425
Accrued income and other	**1 155 224**	638 216
TOTAL CURRENT ASSETS	**7 983 043**	8 253 965
Equipment	**570 224**	558 229
Other assets	**1 142 246**	1 142 246
Patents and licenses	**6**	6
Financial assets	**10 000**	10 000
TOTAL NON-CURRENT ASSETS	**1 722 476**	1 710 481
TOTAL ASSETS	**9 705 519**	9 964 445

LIABILITIES	31.12.2020	31.12.2019
Accounts payable	**84 372**	311 535
Accrued expenses	**5 114 587**	4 988 884
Provisions	**768 538**	1 268 538
TOTAL FOREIGN FUNDS	**5 967 497**	6 568 957
Share capital	**40 000**	40 000
Research funds reserve	**1 734 278**	1 400 000
Special reserve	**1 600 000**	1 600 000
Retained earnings	**355 489**	266 645
Net income	**8 255**	88 843
TOTAL OWN FUNDS	**3 738 022**	3 395 489
TOTAL LIABILITIES	**9 705 519**	9 964 445

Profit and loss statement (CHF)

INCOME	2020	%	2019	%
Swiss Confederation Art. 15	**2 527 300**	20.0	2 420 100	19.7
Canton of Valais	**2 250 000**	17.8	2 000 000	16.3
City of Martigny	**700 000**	5.5	700 000	5.7
Capital and donations	**77 712**	0.6	161 951	1.3
Competitive funding	**5 555 012**	**44.0**	5 282 051	**43.1**
Swiss National Science Foundation	**2 037 286**	16.2	2 431 685	19.8
EU	**1 145 440**	9.1	1 103 182	9.0
Innosuisse	**1 289 801**	10.2	736 080	6.0
Others (The Ark, Hasler, industrials, Bio, US, Valais Ambition)	**2 325 584**	18.4	2 398 913	19.6
Third-party contributions (non-competitive)	**6 798 111**	**53.9**	6 669 860	**54.4**
Interest	**15 900**	0.1	10 453	0.1
Subletting	**170 193**	1.3	163 225	1.3
Other incomes	**49 755**	0.4	124 197	1.0
Profit/exchange loss	**25 252**	0.2	10 506	0.1
Divers incomes	**261 100**	**2.1**	308 381	**2.5**
TOTAL INCOME	**12 614 223**	**100.0**	12 260 292	**100.0**

CHARGES	2020	%	2019	%
Personnel (including social deductions)	**10 631 009**	84.3	10 000 132	82.2
Operational costs	**2 140 681**	17.0	2 061 067	16.9
Dissolution of reserves	**-165 722**	-1.3	0	0.0
Provisions	**0**	0.0	110 250	0.9
Expenditure	**12 605 968**	**100.0**	12 171 449	**100.0**
TOTAL EXPENDITURES	**12 605 968**	**100.0**	12 171 449	**100.0**
OPERATING PROFIT/LOSS	**8 255**		88 843	

Accounting analysis 2020

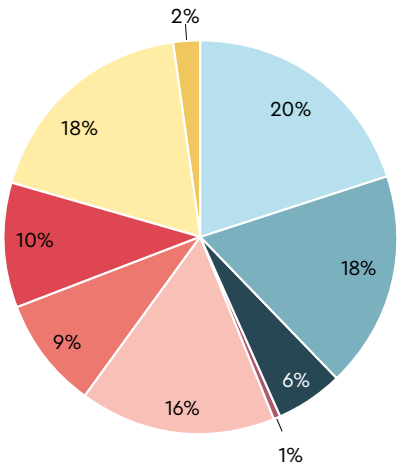
In 2019, the 12 million franc income mark was crossed for the first time. In 2020, Idiap set a new record. Revenues amounted to CHF 12,614,223, resulting in a profit of CHF 8,255. As in previous years, the increase in financial entries related to research and technology transfer projects testifies to the dynamism of the Institute. Our diversified portfolio of projects, along with our multiple sources of financing, allow the Institute to look serenely to the future.

Federal, cantonal, and municipal subsidies
(In thousands of Swiss francs)

YEARS	2017	2018	2019	2020
Confederation	2 418	2 334	2 420	2 527
Canton	2 000	2 000	2 000	2 250
Municipality	700	700	700	700

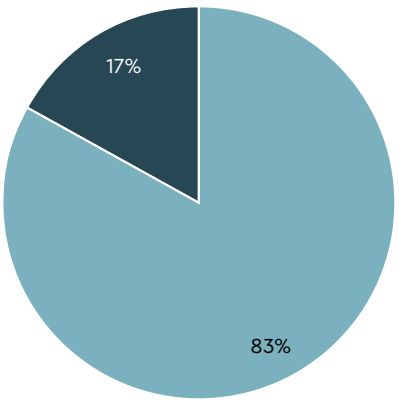
Distribution of funding sources

- Swiss Confederation
- Canton of Valais
- City of Martigny
- Capital and donations
- Swiss National Science Foundation
- EU
- CTI/Innosuisse
- Others (US, The Ark, Hasler, industrials, biometrics lab, Valais Ambition)
- Other incomes



Distribution of costs

- Personnel expenses
- Operating expenses



research

22—27

Swiss algorithms to help customers of a Finnish shopping mall

Human–robot interactions often lack fluidity, especially outside of the lab. Researchers from Idiap have published open-access algorithms that will allow a robot to be used in real conditions in a shopping mall in Finland, in the framework of the European project Mummer.

Answering customers' questions in a shopping mall, a particularly mundane task. But for a robot it's quite a challenge. Of course, to perform this task the robot must be able to understand the questions. Beyond that, to converse without confusion the robot must be able to detect people around it, to identify people interested in it, to differentiate between a discussion between two other people and when someone is addressing the robot directly, and to check if people are paying attention. "The aim is to develop algorithms that analyze audio and video signals captured by the robot to extract non-verbal communication elements," explains Jean-Marc Odobez, head of the Perception & Activity Understanding group. To have a robot able to interact in everyday locations is an additional challenge. Researchers from Valais and elsewhere in Europe took up that challenge in a shopping mall two hours' drive from Helsinki, where they tested and refined their technologies. Thanks to Idiap's work, the experiment showed that in the video captured by the robot it is possible to recognize and rapidly identify speakers in real-life lighting conditions.

Continuous recognition of a speaker and an open-source approach

"The confusion between one person and another is the main technical obstacle to using robots in a public area, where speakers are numerous. A single error is enough for the robot to lose its record of the conversation and to start the dialogue from the beginning or to continue with the wrong speaker," Odobez explains. To evaluate and improve the robot's performance, researchers recorded many interactions in real-life conditions. Then they created a database that includes a description of each interaction: at whom is directed the speaker's gaze, who is the interlocutor of the speaker, etc. The last step was to analyze these interactions with an algorithm in order to compare the results and to refine the algorithm. Unique in the field of human–robot interaction, the database and the algorithms were shared with the scientific community , enabling more effective evaluation of other, improved algorithms in the future.

Multimodal algorithms able to learn from less data

The robot must be able to identify a human voice in a noisy environment and to localize it. This enables it to turn its "head" toward the speaker to gauge the person's gaze direction, so it can determine who the person is talking to. Oral communication is essentially multimodal, implying more than just vocal content. Idiap specializes in multimodal analysis. "Analyzing a combination of visual and audio signals significantly improves the continuity and the flawlessness of interactions," explains the research engineer in charge of the remote piloting of the robot during the three months of real-life testing in Finland.

The high level of success in recognizing and maintaining interaction with a speaker is one of the feats of the Finnish trial. To achieve this, Idiap researchers developed learning techniques with so-called low-labelled data. "Usually, to use machine learning we have to provide the algorithms with a lot of audio or video data, including a lot of associated information. But automatically collecting this information is difficult and the labelling process is lengthy and expensive," Odobez explains, and reducing those costs is crucial. To learn to localize a sound source it is usually necessary to record one or more sounds and to label where each source is. With the new algorithm, meanwhile, mentioning the number of sounds is enough and there is no need to localize them, which results in a more efficient approach.

AI for media: Less fake news, more ethics

The European project AI4MEDIA started in September 2020, assembling 30 partners. Idiap and the HES-SO Valais-Wallis are participating. Via the project, researchers and media actors are workin toward an improved ethical dimension for the artificial intelligence used in the media.

Billions of tweets, online articles, and shared videos are available online. To identify untrustworthy content, algorithms are indispensable tools, enabling automated analysis. But these screening technologies, based on artificial intelligence, often lack transparency regarding their underlying processes and the databases of examples used to teach them to recognize undesirable content. The diversity of media available—videos, texts, and pictures—makes screening even more challenging, and highlights the need for a more ethical approach. One cannot rely only on the tech giants' good will. The European project AI4MEDIA aims to ensure that transparent and ethical approach. Idiap and the HES-SO Valais-Wallis are the only Swiss partners.

The ability to understand and trust

Idiap's Social Computing research group will bring crucial expertise to bear, evaluating the public's comprehension of and trust in technologies that are based on artificial intelligence. "People and organizations must trust the tools they use," explains Professor Daniel Gatica-Perez, head of the group. "This implies that the technology must be transparent about where it comes from and how it works. This way, the user can really evaluate its reliability." The professor's research group is currently involved in a study of trust in media and the media, with the support of the Swiss Initiative for Media Innovation. The group is also part of another national study, which is measuring the social and psychological impact of COVID-19-related confinement. For these studies, the team uses an app whose platform was developed at Idiap.

A sensitive issue

"Media content is easier to access and use than medical data, but its automated analysis requires much work," cautions Professor Henning Müller of the Research Institute of Information Systems at the HES-SO Valais-Wallis. "When we develop an algorithm, constraints are as much technical as ethical. The aim is not to create censorship; rather to create a context-checking tool." Thanks to the European dimension of the project, the integration of various sources, languages, and cultures will allow potential biases to be dissipated. It will, for example, be possible to imagine proposing a kind of label that certifies a website's information reliability, as is done in the medical field. "The aim is to offer artificial intelligence with a human touch, more centered on our needs while maintaining quality and reliability standards for the production of media content," Professor Müller concludes.

A smart scooter for improved battery management

From bikes to cars, batteries are a key element of electric mobility. Managing the autonomy of these vehicles is challenging. Using machine learning and smart scooters, Idiap researchers intend to enhance battery charging plans, and contribute to a better mobility experience.

Electric vehicle fleets are not easy to manage. Batteries take time to charge and their remaining autonomy depends on many variables, including weather conditions, user habits, and local circulation constraints. Having a model that smoothly anticipates battery maintenance can be a real advantage for a battery exchange network. Thanks to Innosuisse—the Swiss federal innovation agency—the e-scooter rental company Mobi-Let is currently collaborating with Idiap's researchers. By using e-scooters equipped with wireless sensors, they aim to develop and calibrate a battery management program. The project will last six months and includes a scooter based at the Institute, in Martigny.

"'Can I reach my destination?' 'How much autonomy do I have?' These are some of the typical questions an electric vehicle user will have," explains Huajian Qiu, student in the Energy Informatics research group. "The remaining electric charge isn't enough of an answer. The battery will last less or more time depending on the driving style, temperature, and—of course—the road we take to reach a specific destination." To monitor the battery and these parameters, the researchers employed various sensors on the battery, including a thermometer, a hygrometer, an accelerometer, an ampere- and voltmeter, and a GPS. Thanks to the Internet of Things (IoT), they can access the data wirelessly. "When we combine our model with Google Maps, we can estimate if a destination can be reached at a given time," Qiu adds.

Moreover, such knowledge can improve the battery's life thanks to better management of its state of charge. This saves money and also diminishes environmental impact by giving batteries a second life in battery exchange stations, where older batteries can serve as a buffer for those batteries still being actively used in electric vehicles.

Privacy and autonomy

To calibrate the machine learning model, the researchers are using data—several battery cycles are usually necessary to learn from a given user pattern—and also data visualization tools. The sensors must be checked to ensure they are producing useful and accurate data. "During the development phase, we need to gather data specific to each user," explains Jérôme Kämpf, head of the Energy Informatics research group. "Of course, for privacy reasons these data are not shared and are only used within the Institute." In the next phase, during commercial deployment, the company plans to use a specific tool to anonymize collected data thanks to a partnership with the HES-SO in Sion, using a solution from Pryv. Kämpf concludes, "The aim is to have a model that classifies individuals while respecting their privacy. Machine learning is the best tool to enable us to reach this goal."

TV drama *CSI* helping progress toward AI-based investigations

Coordinated by Idiap, the Roxanne project aims to introduce AI technologies for law enforcement agencies. The TV drama *CSI* was part of the first data set used to demonstrate early technologies developed by the project partners.

Watching the TV series *Crime Scene Investigation* (*CSI*) is usually thrilling for viewers, as they look for various clues in order to solve the case in any given episode. Phone calls, e-mails, and interviews with people are among the various elements that can provide the key to solving a case. As humans, we are used to combining these different sources to create links, and to extracting meaningful information. But what about computers? Using AI techniques such as network analysis and machine or deep learning, researchers can "feed" a computer program with these same elements. The goal is to teach the program to create similar connections. Funded by the European Union and coordinated by Idiap, Roxanne brings together researchers, industry, and a range of policing actors, from 16 countries, with the aim of developing a realistic, useful tool based on AI and of making investigations more effective.

In real-life cases, the main obstacles come from the variety of sources—voice recordings, text messages, pictures, videos, fingerprints, etc.—and the variety of formats used by the different law enforcement agencies. In their design and development of a flexible solution, the project partners are aiming for maximum autonomy, and to avoid dependencies between components. Standardized interfaces are another element crucial to getting a service up and running.

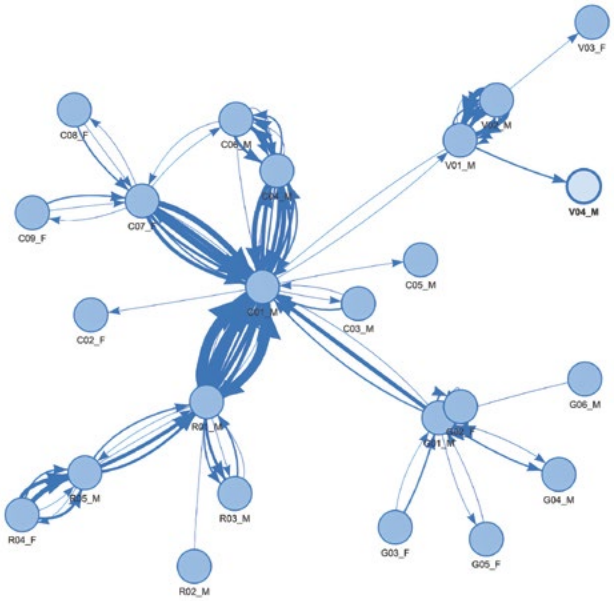
The architecture of the integrated technology is based on a set of tools developed by a group of partners. They designed its multi-source, multimedia analysis solution using the concept of generic architecture, which enables the regrouping of multimedia-processing software products and their presentation in different possible configurations, based on one common and generic architecture. This approach offers a lot of flexibility by allowing the testing and validation of all requested configurations on the same platform during the project.

Training with *CSI* and old cases prior to an initial release

There are legal and ethical issues associated with acquiring real investigation data for developing and testing speech, text, video, and network analysis technologies. Nevertheless, several data sets are already available and can be exploited based on their nature and partial suitability for the project. Among these data sets are numerous phone calls involving a lot of speakers, over 500,000 anonymized e-mails, and phone transcripts and episodes from *CSI*, the popular American procedural forensics drama. Each episode consists of a video of about 40 minutes, an audio file, and a transcript. The audio and video are extracted from the DVD of the show. The transcripts were published by the University of Edinburgh, and also contain the role of each speaker (suspect, killer, or other).

The first field test was a success, 80 participants attending virtually. It involved numerous technologies, including automatic speech recognition, speaker identification, gender identification, keyword and topic detection, named entity recognition, and network analysis. These technologies are essential to extracting meaningful information from the data. Gender detection, for example, can narrow down the search for a suspect. Early results provided by the partners have been incorporated in an interactive network analysis tool, which displays for each node in the network the identity predicted by the speaker-identification system and the gender predicted. Such a tool will be able to support police services in the identification of speakers involved in criminal investigations.

An important aspect of the project is required by the European Commission in order to have it comply with ethical, social, and privacy criteria. The project is reviewed on controlled on a regular basis. Partners will receive two further releases, one in 2021 and another in 2022.



Example of the network analysis tool's potential

commitment

28—33

Graduate in Artificial Intelligence and influencing an entire company

The first intake of students of the applied Master's in Artificial Intelligence just graduated. Offered jointly by Idiap and the Swiss Distance University, the course of study has enabled one engineer, from Syngenta, to become one particular production's site artificial intelligence specialist, supporting the site's digital evolution.

In January 2019, a young engineer at Syngenta in Monthey named Edwin Kerouanton received a phone call while at a freeway rest area. He accepted, without hesitation, the offer, which would see him developing artificial intelligence-based tools. A few weeks later, Edwin was once more a student, but this time around he was a student with an employer. Eighteen months later and along with nine other pioneers he is about to receive his Master's in Artificial Intelligence. The particularity of this degree course is to link theoretical learning with a project carried out for the employer. The demanding curriculum is divided in two: one half dedicated to the job, the other to study. Machine learning, neural networks, programming—all these topics are covered by the courses provided by Idiap researchers. And the Institute's role goes beyond teaching students, as each company is coached individually depending on the needs of its project, which might, for example, involve Industry 4.0.

Identifying the employer's needs

Head of the Method group at Syngenta, Hernan Aguiar was part of the team that selected eight projects that could potentially be developed using artificial intelligence, ranging from quality control to resource optimization. "We evaluated the feasibility and the level of priority of each of the projects in collaboration with Edwin and Idiap. Based on that analysis, we decided together to work on an apparently simple task: renaming e-mails and pdf documents," Aguiar explains. "Until then, people had had to carry out this time-consuming task—and we're talking of around 350 hours per year—which is a source of potential errors," adds Pascal Saudan, quality control specialist for the production site. "But the work is crucial to ensuring the tracking of our operations and of deliveries of raw materials from around 180 suppliers."

The first step was to understand the company's needs. "It's important for the workflow of the engineer and even more for the implementation of artificial intelligence," Kerouanton explains. "The quality of AI depends on the use of relevant data, which is why I spent so much time with my colleague Pascal Saudan. Our discussions helped him to have a clearer vision of his needs."

Optimization and a cross-sectoral strategy for economies of scale

Today, the time apportioned to this task has already been cut by 60 percent. The final goal is an 80 percent reduction. "We now have more time to dedicate to more significant tasks," emphasizes Saudan. Another advantage of this project is that it can be exported to other departments and even to other sites of the group. "We have data for energy saving, and for raw materials, predictive maintenance, and process optimization," Aguiar explains. "It's now up to us to exploit those data with these new tools."

While most companies could theoretically harness the potential of artificial intelligence, identifying available data and ways of effectively exploiting them is a real challenge. "Thanks to our experience, we can support our partners in implementing the project that meets their needs and matches their resources," says Joël Dumoulin, Technology Transfer Officer at Idiap. Just such an approach contributed to Edwin Kerouanton's success at Syngenta, and motivated the company to repeat the experience, by hiring a new student-employee.

A million pictures to check manually

To diminish facial recognition biases, data sets of representative pictures are necessary. Idiap decided to go a step further, by participating in the creation of an ethical picture data set.

If you are a white male, algorithms usually perform well in recognizing your face. The success rate is lower if you are a women or have another skin color. These biases don't mean that artificial intelligence is programmed to discriminate. They exist because computer programs are trained with examples that do not reflect human diversity. To compensate these inequalities and improve facial recognition systems' security, the Biometric Security & Privacy research group is creating a new and more reliable database. This initiative is linked to a partnership with a private company operating in the field of security.

Ethics and confidentiality

"Usually, this kind of picture annotation work to produce metadata—so, for example, gender or eye color—is crowdsourced on online platforms such as Amazon Mechanical Turk," explains Sébastien Marcel, head of the research group. "Anyone can contribute and be paid a small amount for checking a small chunk of the data set. Besides the resulting "Uberization" of such tasks, there are confidentiality issues." The data set created at Idiap is related to a project ongoing with an industrial partner. For security reasons, the project agreement specifies that the data cannot be distributed and must reside at Idiap.

Reliability to fight biases

In an office at Idiap, four figures sit at screens comparing sets of pictures and validating them. "The hardest challenge is to stay focused," comments Magali. "To succeed, you have to take frequent breaks," adds Josselin. "Every hour," adds Oriane. Eight hours a day, for one or two weeks, they are contributing to a long and very demanding task. "It's sometimes harder with some types of pictures or people," Léo explains.

The cost of this task is significant, around 20,000 Swiss francs. The young people employed to carry it out are discovering Idiap and the challenges of picture annotation while being paid 20 Swiss francs per hour. The same kind of mandate from foreign companies can pay up to twenty times less. "The fact that we are doing this ourselves allows us to check more quickly the quality of our data base," Sébastien Marcel points ou. "The 'cleaner' a data base, the better and more reliable are the results of the machine learning program."

Idiap becomes an accredited center for Android

To manage the increasing use of biometrics systems, Android has set up its own certification standard. Idiap's biometrics center is accredited to deliver certificates meeting that standard. This competence builds on the FIDO accreditation obtained in 2019.

More and more apps are using biometry. The use of biometric data ranges from user identity verification to payment validation. The reliability and the trustworthiness of these apps is a question of how they were developed. To control their level of security, their biometric features must be audited respecting a common standard. Like all of its peers, the value of Android's certification lies in the fact that a third party can carry it out. Idiap's Swiss Center for Biometrics Research and Testing has received the accreditation necessary for it to conduct the evaluations required by Android.

A constantly changing field

As technologies continually evolve, the reliability of security systems based on biometrics must be constantly improved. It should not, for example, be possible to use a picture, a video, or a mask to impersonate an individual. The validation of the biometric features of an app is a key element in the establishment of security standards.

Created in 2014 with the support of the Canton of Valais and the city of Martigny, Idiap's biometrics center is among the few laboratories accredited by Android. The accreditation adds to the FIDO benchmark accreditation received in 2019. Idiap's laboratory for biometrics testing uses a dedicated room, with data acquisition hardware, a test bed, and masks for simulating spoofing attacks on face recognition systems.

How the Swiss fared under partial lockdown

A joint study by Idiap, EPFL, and the University of Lausanne has provided a unique snapshot of how Swiss residents experienced the partial lockdown measures resulting from 2020's coronavirus pandemic. The findings include gender disparities, doubts about the future, and hopes for change.

From 8 April to 10 May 2020, at the height of the partial lockdown, a team of local researchers used social media and various other channels to distribute a multilingual survey throughout Switzerland, querying recipients about how they were adapting to life under lockdown. The goal was to assess respondents' professional and personal quality of life with an eye to creating more effective support structures in the future.

A total of 6,919 people responded, providing the team with significant insights. The survey data was rounded out with semi-structured interviews with 60 individuals and feedback from 216 others via the "Civique" mobile app—a optional download proposed at the end of the survey. Using the app, individuals were able to more actively participate in the study, at intervals of several weeks. They shared their personal experiences and photos of their homes as they evolved to meet the demands of remote working and home schooling.

New ways of living and unequal burdens

The results revealed that 55% of respondents worked remotely while 40% lived with at least one remote worker. Only 8% reported a lack of comfort in their homes, and the most common challenge was how to reorganize and adapt living space to changes in private and professional lives. Overall, the idea of widespread remote working for an extended period of time was thought to be undesirable.

Clearly the partial lockdown resulted in—or heightened—many forms of gender inequality. Whereas only 3% of respondents reported losing their job, 70% of those who did were women. The majority of women also felt that their working conditions had become more difficult; a large proportion of them stated that they were employed in the health and social services sector, and therefore ran a greater risk of infection. People working in this sector reported that they felt most useful during the crisis, but also that they would have liked to have been better rewarded for their efforts, through compensatory leave, holidays, or financial compensation.

One woman in two reported being solely responsible for home schooling, compared with only one out of every 10 men. Interestingly, significantly more men than women stated that this task had been shared. "Men may have had the impression that they were handling the schoolwork, or that they were doing so more often than in the past," says Laurie Daffe, a postdoctoral researcher. "This feeling was not, however, shared by their spouses or reflective of the actual distribution of labor."

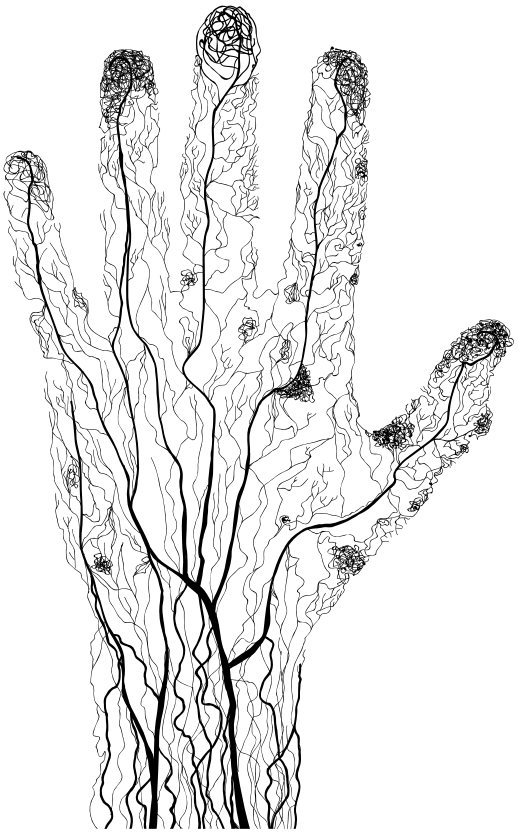
New social initiatives, and contradictions

When it comes to mobility, as other studies carried out during the lockdown have shown there was strong support for limiting car journeys and work-related travel—a change dependent on employers' flexibility, as those surveyed pointed out. "When studying different mobility scenarios, we observed that there was an implicit conflict between the desire to move toward a societal model that supports modes of transport other than private cars and the concern that public transport would be shunned out of fear of contamination," Daffe says.

"Generally speaking, we noted a contradiction between, on one hand, respondents' desire for social change, eco-friendly approaches, and greater involvement at the local level, and a rather disillusioned view of the future on the other," says postdoctoral researcher Garance Clément. "People are now looking for collective ways to turn such ideas into tangible initiatives, because they are not convinced that the public authorities themselves have the ability to do so."

Hygiene and cyber precautions, a key challenge for hospitals

With a 1 million Swiss franc budget and supported by Innosuisse, the project CANDY will develop and patent a contact-less scanner to identify individuals using the venous patterns of their hands. The project is a collaboration between the start-up Global ID and Idiap.



Fingerprint identification is often a good security measure, but in hospitals the method raises some obvious hygiene issues. Vein recognition technology's advantage is that it can be contact-less. Individuals are identified by reading the pattern of the vein network in their hands, which is unique to each person. The imaging of the veins can be carried out at a distance using the near infrared light domain. The challenge is to offer a device that is able to satisfy users and is both fast and secure. The research and development project between the company Global ID and Idiap will enhance this technology, and allow them to share it with health professionals.

Faster, safer, and cheaper

"Our ultimate goal is to ensure a high level of security and data confidentiality, while solving the main issues of existing biometrics technology, such as reliability, robustness, and high costs," explains Lambert Sonna, Global ID's CEO. "We have already created a device able to scan through a surgical glove; now the goal is to make it contact-less and fast." To achieve this, a multispectral sensor—so, one sensitive to various wavelengths—will be used.

To stop intruders cheating the system, the device's level of security is high, not only due to the multispectral approach but also thanks to its use of high-definition images of the whole hand. "Even if venous identification is not very common, it is crucial to be able to detect potential presentation attack intrusions from the outset," explains Sébastien Marcel, head of Idiap's Biometric Security & Privacy group.

Planned to last two years, CANDY will develop a pre-industrial prototype of a portable venous scanner and also seek to file an international patent. Once the pandemic is behind us and the moment comes to improve security technologies in the health sector, the project will provide some vital, timely answers.

faces

34—39

"This place has to be welcoming"

An increase in employee numbers led Idiap to recruit its own caretaker. Assisted by two helpers, he takes care of the building, keeping it clean and welcoming. We followed him "backstage" to learn about his work.

Ragip, Nazifa, and Nazmije's mission is to take care of Idiap's building, so everyone can feel good at work. After only a few weeks their colleagues have already noticed their contribution. We talked to them, in an attempt to learn some of their secrets.

How have you managed to make such a quick, visible impact with your work?

Ragip: We were lucky to work in an almost empty building due to the confinement during the pandemic. It allowed me to clean the carpets using heavy-duty hardware. Then, the contract with the cleaning company ended and I was able to hire my two helpers at the beginning of June.

Nazifa & Nazmije: We helped to finish the cleaning. We had to sanitize everything. We also installed closed trash cans in the offices and paper recycling bins.

Did you know of Idiap prior to starting work?

Ragip: Yes, in was in politics for 12 years in Martigny, so I know a lot about what is going on in the city. I've always considered Idiap to be an exclusive place, at the forefront of technology. When I heard about the job opening, I took my chance and immediately applied. The most difficult part was to wait for two weeks for the answer after my interview. For the record, I worked in the building before Idiap arrived. There was, for example, a night club in basement, on the hotel side of the building.

Nazifa & Nazmije: Not particularly, but we feel welcome. Ragip invited us to join him and to work here.

What are your duties at Idiap?

Nazifa & Nazmije: In the morning, we clean the coffee machine, we check all the offices, and then we start to clean the toilets. It's a lot of work to have everything spotless on each floor. Sometimes, we are also in charge of cleaning Idiap's studio apartments when someone is leaving.

Ragip: We work together, because it's a lot of work and it goes faster together. I also hope that we will soon have the time to really clean the cafeteria's kitchen. There's a lot to be done there: we have to empty everything and scrub it all. Idiap has to be a place that's clean, and one where you feel welcome.

"I've always considered Idiap to be an exclusive place, at the forefront of technology."

Ragip Limani, Caretaker

"We were inspired by Berkeley"

Your first point of contact when you arrive at Idiap, the Secretariat is responsible for administrative tasks: from human resources to managing accommodation for researchers. Leaving a post she has occupied for over two decades, Nadine Rousseau shared her 23 years of experience with Laura Coppey.

Belgian Nadine Rousseau was probably never going to settle down in California. She did in Valais though, in 1996, at her husband's side. Both participated in Idiap's growth. Fast-forward two decades and Nadine is sharing her legacy and her knowledge with Laura Coppey, who is taking over her role at the Secretariat. Other than their work and their smiles, the two women possess the same dynamic aura, which they agreed to share with us in an interview.

In 23 years the Institute has evolved considerably; how did that evolution impact the Secretariat's work?

Nadine: At the Villa Tissières [editor's note: the building where Idiap began], my colleague Sylvie and I were in a small space on the landing on the first floor, sharing a computer and a chair. That created a strong bond and a friendship. We have come a long way since then!

When we were in Berkeley, my husband and I really appreciated how housing and help upon arrival were organized prior to our stay. That's what we wanted to recreate at Idiap. That little extra provides not only a human touch, but also precious help. And it also meant that the Secretariat's work expanded and developed. Today we manage 32 real estate objects with rental agreements signed by the institute, and since 2019, we own six of these. It requires constant real estate management. The increasing number of researchers also

adds up to an important workload: travel, coordinating agendas, travel requests, reimbursement requests, etc. It's a job with a lot of human exchanges, where you can't sit in a chair all day long. It demands a lot of energy and availability.

"I really appreciate working in a multicultural environment; it's very rewarding."

Laura Coppey, Administrative Assistant

Laura, are you not scared to take over such a structure?

Laura: No, Nadine is leaving behind a well-functioning organization. I feel ready. What impresses me is what she, personally, knows. For example, she knows by heart the inventory of each of the properties, as well as the names of the people living there. For my part, I plan to supplement the files with pictures, which will help me to remember the contents of each apartment.

I've also noticed that we use different tools for our work: Nadine is more paper oriented, while I'm more into using computers; but she remains open to new approaches. I'm also thinking about ways of offering a "distance welcome" to new people arriving at Idiap, for example when they arrive during the weekend or a holiday. Until now, Nadine was waiting for them at the railway station, or left a key at the railway station office.

How did the collaboration go with the researchers in such a multicultural environment?

Nadine: It's went very well, but the researchers are often in their bubble, and sometimes, despite their considerable knowledge, need help with problems as simple as changing a light bulb, or a malfunctioning hotplate. For the rest, it's a question of tact and of—always with a smile—getting my message across according to the various cultural backgrounds represented here.

Laura: The same. I really appreciate working in a multicultural environment; it's very rewarding. It's also a real opportunity to practice and improve my English.

Nadine, what is your wish for the future of Idiap?

Nadine: I hope the Institute will keep on track and that its evolution will preserve this vision of a unique place. During these 23 years I was really involved, always with a lot of pleasure and giving freely of my time, but I also received a lot in return. Each arrival or departure of a colleague is a moving moment... Idiap will always be something special and unique to me.

Laura: I agree with Nadine regarding Idiap's future. I really like the significant autonomy we enjoy. You can feel that the working relationship is based on trust, and that motivates people to get involved.

Prizes and distinctions

At the end of each year, the Institute awards two honors: the Student Award and the Paper Award. Idiap's 2020 Awards went, respectively, to Lesly Miculicich and Adrian Shajkofci.

Idiap PhD Student Award 2020

Lesly Miculicich's main research contributions have been on deep learning models for natural language processing at the document level, particularly applied to machine translation. Her hierarchical attention network model of document translation has been widely recognized, and her graph-based Transformer model of coreference resolution sets a new standard. Lesly started her PhD in March 2016 and defended her PhD thesis in October 2020. She has consistently produced high-quality publications that receive many citations (H-index: 8). This year she carried out internships at Google Research and Microsoft Research. She will soon be starting her independent research career as a research scientist at Microsoft.

Idiap Paper Award 2020

Adrian Shajkofci with his journal paper "Spatially-Variant CNN-Based Point Spread Function Estimation for Blind Deconvolution and Depth Estimation in Optical Microscopy" published in *IEEE Transactions on Image Processing*, Vol. 29, 2020.

Other researchers also received recognition

Exemplary Reviewer for the *IEEE Wireless Communications Letters*

Lakmal Meegahapola
January 2020

10-year Impact Award at the 19th International Conference on Ubiquitous and Mobile Multimedia (MUM)

Trinh-Minh-Tri Do and Daniel Gatica-Perez
November 2020

Theses completed

12 students published their theses in 2020.

Deep generative models and applications
Tatjana Chavdarova

Detection of disguised speech in forensic science by humans and automatic systems
Michela Pettinato

Active illumination and computational methods for temporal and spectral super-resolution microscopy
Christian Jaques

Understanding eating and drinking in context from crowdsourced data
Trung-Thanh Phan

Robot skills learning with riemannian manifolds: Leveraging geometry-awareness in robot learning, optimization and control
Noémie Jaquier

Product of experts for robot learning from demonstration
Emmanuel Pignat

Context is everything: Using a smartphone app to capture young people's drinking behaviours, cognitions, environments, and consequences
Florian Labhart

Weakly supervised deep learning methods for biomicroscopy
Adrian Shajkofci

Discourse phenomena in machine translation
Lesly Miculicich

Multilingual training and adaptation in speech recognition
Sibo Tong

Trustworthy face recognition: Improving generalization of deep face presentation attack detection
Amir Mohammadi

Accurate nod and 3D gaze estimation for social interaction analysis
Yu Yu

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