The 30th IAHR Symposium on Hydraulic Machinery and Systems (IAHR2020) was held virtually between March 21-26, 2021, and organized by École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland.

EPFL is one of the two Swiss Federal Institutes of Technology. With the status of a federal institute since 1969, the young engineering school has grown in many dimensions, to the extent of becoming one of the most famous European institutions of science and technology. Like its sister institution in Zurich, ETHZ, it has three core missions: training, research and technology transfer. Associated with the four specialised research institutes, the two Institutes of Technology form the ETH/EPF domain, which is directly dependent on the Federal Department of Economic Affairs, Education and Research (EAER). EPFL counts some 6,000 employees and 1,500 academic visitors per year who work at our five schools, two colleges, 28 institutes, 354 laboratories and sites in five cantons and who span over a hundred different professions (professors, secretaries, PhD researchers, lab technicians, tech support staff, etc.).

Among EPFL laboratories, the EPFL Technology Platform for Hydraulic Machines (EPFL PTMH) has been a worldwide reference for research and testing in the field of hydraulic machinery and systems since 1969. It is at the forefront of performance characterization and stability assessment in turbines, pumps and pump-turbines, both through measurements and numerical simulation. EPFL PTMH has unique experimental facilities for the reduced scale physical model testing of hydraulic machines according to IEC 60193 standards, which validated the generating units of many of the world’s most important hydropower plants.

About the conference

The International Association for Hydro-Environment Engineering and Research (IAHR), founded in 1935, is a worldwide independent organization of engineers and water specialists working in fields related to the hydro environmental sciences and their practical application. IAHR stimulates and promotes both research and its application, and by so doing strives to contribute to sustainable development, the optimisation of the world's water resources management and industrial flow processes.
The IAHR-Committee on Hydraulic Machinery and Systems deals with the advancement of technology associated with the understanding of steady and unsteady characteristics in hydraulic machinery and systems connected to the machinery. The fields of interest include the fluid behaviour within machine components, hydro-elastic behaviour of machine components, cavitation, instabilities in turbines and pumps, control systems of hydroelectric units, the use of hydraulic machines to improve water quality, and even considerations to improve fish survival in their passage through hydro plants. Because reduced scale model tests carried out in laboratories must be scaled down from the full-size prototypes, studies on the scale effects and transposition laws are also key topics. The research work in the Committee creates a fundamental knowledge for the IEC standards dealing with hydraulic machinery for hydroelectric power plants. The IAHR-Committee on Hydraulic Machinery and Systems puts great emphasis on the incentive of cutting-edge research and development activities on the technologies associated with hydraulic machinery and systems, and on the promotion of fruitful interactions between the academic community, key stakeholders, such as machines designers, manufacturer and users, and the community as a whole.

Within this framework, the 30th IAHR Symposium on Hydraulic Machinery and Systems (IAHR2020) has been an excellent opportunity to exchange with leading scientists and industry experts about the latest advances in the aforementioned fields of interest.

IAHR2020 was originally scheduled in July 2020 in Lausanne, Switzerland. Unfortunately, due to the current COVID-19 pandemic restrictions and the international worldwide participation of the peers, it was not possible to hold the conference in Lausanne (Switzerland) as originally planned. Therefore, IAHR2020 was postponed to March 2021 and further changed to a virtual format through Zoom and SwissTech Convention Center (Switzerland) streaming platforms. A further postponement was not possible since this conference takes place every two years, and it would have been too close to the 2022 edition of the conference. However, from a scientific point of view, the conference had a great impact and success even in virtual format.

About 220 scientists and researchers from 28 countries from universities, research centres and industries participated to IAHR2020 to present and discuss cutting-edge research activities and industrial developments on the latest progresses and new insights on hydraulic machinery and systems, which will enhance the sustainable exploitation of water resources and the hydropower production towards the decarbonization era. The Scientific Committee selected 158 full papers for publication, out of 304 abstracts submitted. All papers, published in this IOP Conference Series: Earth and Environmental Science volume, have been peer reviewed by the conference scientific committee and administered by the editor of the 30th IAHR Symposium on Hydraulic Machinery and Systems proceedings.

**Conference themes**

- **Hydraulic Turbines**: This session invites the presentations related to hydraulic turbines especially on “Design and optimization”, “Multidisciplinary design optimization”, “Unsteady flow phenomena”, “Performance prediction and enhancement” and “Erosion
and cavitating flows.” The final structure of the session will be determined based on the accepted presentations.

- **Pumps**: Topic areas covered by this session include the followings: “Design techniques” including computational methods, “Applications and systems” for general water services, “Simulation and experimental investigation of flow field and performance” including unsteady flows, instabilities, cavitation and verification using testing with measurement devices, “Mechanical systems” including seals, bearings and rotor dynamics analysis, and “Operation, monitoring and controls”.

- **Pumped and Energy Storage**: This session focuses on the following topics: “Flexible systems and operation”, “Technical problems”, “Integration of pumped storage power plants in the global grid”, “Governance and regulation”, “Stability of dikes and dams subjected to pump/turbine operating conditions”, “Coastal and maritime installations”.

- **Pumps Working As Turbines (PAT)**: The idea of using the standard pumps as hydraulic turbines especially for industrial recovery applications has been known for many years. On the other hand, substituting a conventional turbine by a standard pump for hydropower generation is not yet well accepted and there are considerable debates on this subject. The main object of this session is to discuss technical aspects and practical challenges of using pumps as turbines. Topic areas covered by this session include the followings: measurement and numerical prediction of PAT hydraulic and mechanical characteristics (e.g. radial and axial trusts), optimization of PAT, PAT selection and economic concerns. Contributions for both radial and axial machines are welcome.

- **Sustainable Hydropower**: This session welcomes presentations covering sustainable development and challenges in the hydropower projects especially on (but not limited to) “Small hydropower”, “Decentralized development”, “Environmentally-friendly development”, “Operation and Maintenance”, “Load flexibility”, “Energy independence” and “Optimizes power supply”.

- **Ocean Hydro Machinery**: Oceans cover more than 70% of the earth’s surface, making them the enormous source of energy. The area of ocean hydro energy includes wave energy, tidal energy, and marine current energy. This session focuses on the ocean hydro machinery which are mainly used to convert the ocean hydro energy into the mechanical energy for electricity production.

- **Hydraulic Systems**: This session deals with “Dynamic behaviour”, “Valves and gates”, “Water supply systems, “Penstock design and modernization” and “Free surface flows”.

- **Cavitation and Multiphase Flow**: This session aims at gathering, exchanging and sharing information from researchers and engineers about experimental and numerical basic research of cavitation and multiphase flow. It is also welcome to propose new models, numerical methods, measuring techniques and the modifications for cavitation and multiphase flow.

- **Computational and Experimental Techniques**: Presentations about advanced techniques of experiment and analysis are welcomed in this session, such as optical approach for
visualization, multipoint pressure measurement, advanced turbulence models or numerical scheme, transient analysis, etc.

- **General Topics**: Presentations on the topics other than the above are welcomed in this session within the conference scope.

**Conference Sessions**

**Plenary sessions:**
- Opening Ceremony
- Closing Ceremony
- Key-notes:
  - Prof. Giovanna Cavazzini, Università di Padova (Italy), “Fluid-dynamic and spectral characterization of instability phenomena in pump-turbines”
  - Prof. Zhengwei Wang, Tsinghua University (China), “Multi-field coupling analysis of hydraulic machinery”
  - Prof. Sébastien Houdé, Université Laval (Canada), “Challenges and solutions for low-load regimes in hydraulic turbines”

**46 parallel sessions** (4 at the same time) according to the aforementioned conference themes. Each presenter had 15 minutes for the presentation and 5 minutes for questions.

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