FITHYDRO – Fishfriendly Innovative Technologies for Hydropower

Summary

Purpose

FIThydro project concentrated on hydropower and aimed to increase both production and ecology of hydropower and to support development of self-sustainable fish populations. It aimed to bundle competences of the relevant disciplines of science to enhance protection of fish individuals and populations in a most cost-effective way and with maximum societal benefit. This will be attained by employing high-end innovative technical solutions, methods, tools and devices (SMTDs) to overcome existing societal, financial and legislative barriers. FIThydro focuses on the following sub-objectives:

The main objectives were:

- Bringing together all disciplines related to hydropower.
- Assessing the response and resilience of fish populations in HPP affected rivers.
- Environmental impact assessment and species protection.
- Improving fish and fisheries impact mitigation strategies using conventional and innovative cost efficient measures.
- Enhancing methods models and tools to cope with EU obligation.
- Identifying bottlenecks of HPPs and deriving cost efficient mitigation strategies.
- Risk based Decision Support System (DSS) for planning, commissioning and operating of HPPs.
- Enhancing problem awareness and objectiveness of policy implementer, NGOs and the public.
- Testing solutions, methods, tools and devices in difference regions across Europe.

Technologies that have been developed or enhanced in the FIThydro project

Developed in FIThydro:

- 3D fish tracking system.
- 3D sensorless, ultrasound fish tracking.
- Agent based model.
- Bedload monitoring system.
- Fish guidance structures with wide bar spacing.
- Fish refuge under hydropeaking conditions.
- Guidelines for fishpasses numerical modelling.
- Hydropeaking tool.

Figure 1. The horizontal bar rack bypass system at the residual flow HPP Schiffmühle, Switzerland, during revision work in July 2018.

Enhanced in FIThydro:

- Barotrauma detection system.
- CASiMiR.
- COSH-tool.
- Differential pressure sensor base artificial lateral line probe, iRon.
- Double Averaging method.
- Fish guidance structures with narrow bar spacing.
- Fish Protection System (induced drift application).
- Hydropeaking indicator.
- Shaft hydropower plant.
- Vertical slot fishways.

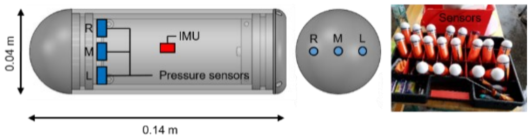

Figure 2. a) BDS sensor dimensions; b) box with prototype sensors (source: Centre for Biorobotics, TUT).

Decision support system

The FIThydro Decision Support System (DSS) is based on a planning and decision framework comprising a sequence of four key steps, each encompassing a series of key considerations and decisions. The framework enables operators and regulators to develop structured proposals for new HPP schemes, and to both, review and risk assess, those proposals whilst identifying appropriate

Project Reference

Grant agreement ID: 727830

Leading Institution

Technical University of Munich (Germany)

Partners

ETH Zurich (Switzerland), Centre national de la recherche scientifique (France), SINTEF (Norway), Hull International Fisheries Institute (United Kingdom), Tallinn University of Technology (Estonia), Instituut Natuur- en Bosonderzoek, Ecologic Institute (Belgium), SJE Ecohydraulic Engineering GmbH (Germany), AFRY (Sweden), LEW Wasserkraft (Germany), Leibniz Institute of Freshwater Ecology and Inland Fisheries (Germany), Hidroerg – Projectos Energéticos, Lda (Portugal), Norwegian University of Science and Technology (Norway), VOITH (Germany), Statkraft (Norway), VERBUND (Austria), SWECO (Sweden), CTAEX – Centro Tecnológico Nacional Agroalimentario (Spain), flussbau IC (Austria), Armin Peter – Haustechnische Anlagen und Energieberatung (Germany), SAVASA CH salto de vadocondes SA (Spain), LKW Limmatkraftwerke (Germany), UNIPER (Germany), BKW (Switzerland)

CERIS Principal Investigator

António Pinheiro (antonio.pinheiro@tecnico.ulisboa.pt)

CERIS Research Team

Isabel Boavida, Ana Quaresma, Filipe Romão, Maria João Costa mitigation measures to address the impact of both new and existing HPP schemes. The framework leads the decision maker through four key steps which act to characterize, risk-assess (and prioritize) the scheme(s) together with the identification of the most appropriate and potentially cost-effective mitigation options addressing the hazards and impacts arising due to the nature and context of the specific scheme(s).

The FIThydro planning and decision framework comprises a sequence of four key steps, each encompassing a series of key considerations and decisions. The framework enables operators and regulators to develop structured proposals for new schemes, review and risk assess those proposals and, additionally, identify appropriate mitigation measures to address the impact of an existing scheme or portfolio of existing schemes within a particular catchment or member state. The framework leads the decision maker through four key steps which act to characterize, risk-assess (and prioritize) the scheme(s) together with the identification of the most appropriate and potentially cost-effective mitigation scenario addressing the pressures and impacts arising due to the nature and context of the specific scheme(s). The four key planning steps are as follows:

- Step 1 Pre-screening characterization, hazard identification & risk assessment.
- Step 2 Ecological status assessment and review of existing mitigation.
- Step 3 Identification of appropriate mitigation measures and synergistic solutions.
- Step 4 Risk-based decision of scheme plan OR Scoping of detailed cost-efficient mitigation plan.

These four steps lead decision makers from simple characterization of a scheme and determination of its spatial and policy context, through a risk-based identification of hazards and impacts on sensitive fish species to identification of the most appropriate mitigation scenarios. The decision process leads ultimately to a structured assessment of the acceptability of a proposed scheme or scoping the measures required for mitigating existing hydropower plants, with associated risks and uncertainty.

Fishway modelling

Many efforts have been devoted to study, develop and optimize fishways design, construction and operation to improve their passability by fish, however fishway science, engineering and practice still remain imperfect (Silva et al., 2018). For a fishway to be fully functional its passability is vital. Nonetheless, its attraction ability is also critical. CFD is nowadays a major tool to study complex flow physics, and may be used to improve the design and operation of hydraulic structures, like fishways, reducing time and costs. The availability of different numerical methods options and its application in fishways calls for guidelines on its optimized use. 2D and 3D modelling of the attraction flow area at the fishway outflow of Guma HPP was performed to analyse hydrodynamic conditions to assess and improve fishway attractiveness. To analyse fishway operation, 3D modelling of the fishway under different flow regimes and operational constraints, such as clogged orifice or notch was conducted as well. From the numerical simulations carried out and from previous numerical modelling experience, a set of guidelines to be considered for similar numerical simulations of fish passage facilities was developed.

Figure 3. Aerial view of the pool-type fishway at Guma HPP.

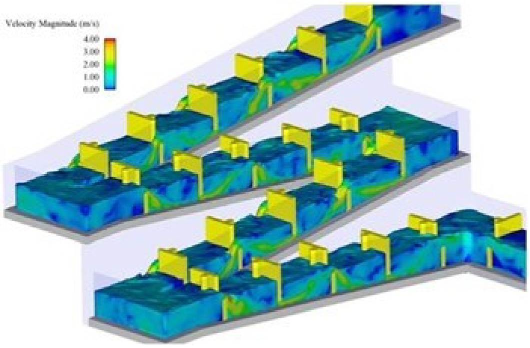

Figure 4. Isosurface of the mean velocity in the fishway at Guma HPP.

Funding

EU Horizon 2020 Framework Programme (5 888 424.00€)

Period

2016-2020

Total

7 171 555.00€

CERIS

290 251.00€

Project Website

www.fithydro.wiki/