Innovation projects within the Balancing Programme

Aug 2023

ESO

Innovation Project: Co-optimisation of Energy and Frequency-containment services (COEF)

Drivers:

- As system inertia reduces with the decarbonisation of the GB energy landscape, the cost of frequency containment services is expected to significantly increase.
- Currently, ancillary services for frequency containment are procured through separate auctions and tenders, decoupled from the energy market, and not considering detailed time dependencies.
- Co-optimisation of energy and frequency containment services would reduce the overall cost of energy balancing and procurement of frequency confinement services.

Project Scope:

- This project will develop a novel software tool, integrating mathematical models previously investigated to achieve co-optimisation of energy and frequency containment services. The tool will link the technical and temporal characteristics of different services, as well as spatial variations in frequency across the network, with the goal of operating the national electricity grid more cost effectively.
- The prototype tool will be developed and tested through engagement with the ESO Balancing Programme and a roadmap for future development into a fully operational model within the Control Room will be produced.

Progress:

- The project team has completed the first work package which defines the requirements and capability of COEF tool.
- The project team is on track to build the first prototype of the tool by the end of 2023.
- Detailed project work packages and progress update can be found on ENA Smarter portal: here.

Imperial College London

ESO

Innovation Project: Course Correction Dispatch Instructor

Drivers:

- Current instruction of units are informed by modelling but dispatch decisions are made largely based on judgement of experienced control room engineers.
- Increasing number of units to dispatch across several services makes the current manual approach increasingly more challenging to maintain economic and reliable operation of the system.
- Building a despatch decision-support tool would release operators of manual tasks and ensure timely decisions are made for economic and reliable operation of the system.

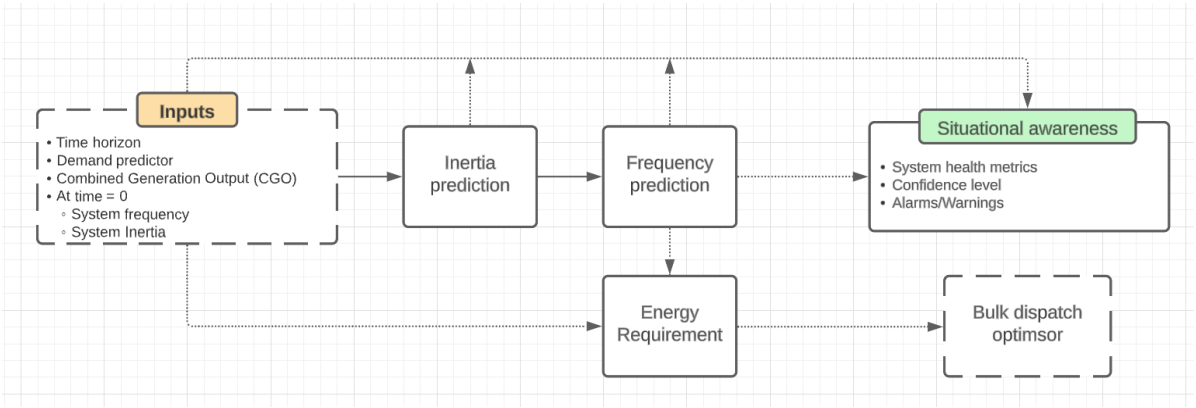
Project Scope:

- This project aims to discover, develop, and test a world first course-correction methodology to balance the electricity system.
- The project will deliver proof-of-concept capabilities for course correction.
- The proof of concept developed and tested using advanced optimisation techniques and data-driven approaches, including development and implementation of a mathematical model, demonstrating the model performance on selected real-world data examples.
- Following successful delivery of the course-correction methodology and PoC, this project will then explore further dispatch support tools covering short-term and long-term energy dispatch, as well as further work to provide explainable solutions within the advice tools developed.

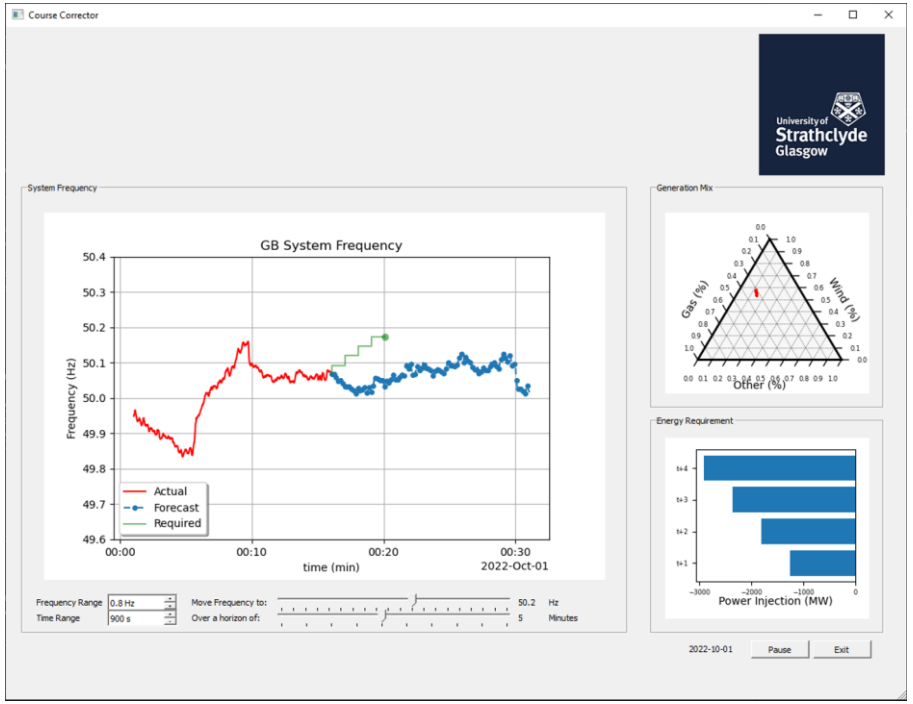
Innovation Project: Course Correction Dispatch Instructor

Progress:

- The main components of the course correction have been identified. Block diagram of the end-to-end framework is provided below
- Predictive models of inertia and frequency have been developed.
- Initial prototype demonstrator has been developed (snapshot below).
- Detailed project work packages and progress update can be found on ENA Smarter portal: here.



The block diagram presents an end-to-end framework of course correction tool. It consists of two key components: predictive models for inertia and frequency, and the energy requirement. The energy requirement is then fed into the bulk dispatch instructor.



Snapshot of first prototype demonstrator

University of Strathclyde

ESO

Innovation Project: Model-driven Strategy for Balancing Optimisation (MSBO)

Drivers:

- Balancing is excessively manual, needs optimisation over multiple time spans, and misses critical capabilities
- As energy system fundamentally change in a way not seen before, radical system-level thinking is critical
- A model-driven strategy is required to the energy balancing system design and enables those shortcomings to be addressed

Scope:

- Develop an Underpinning Balancing Model (UBM) and map existing manual processes to analytical equations. This includes articulating the entire balancing problem with a bespoke mathematically rooted language
- Develop a candidate future balancing system design, where additional control room challenges and needs are identified. The project will deliver design specific problem formulation for future balancing system design.

Progress:

- The project has kicked off and mapping of current control room processes and roles has been initiated.
- UBM overall problem statement has been developed.
- Multi-level architecture of UBM is has been formulated and discussed with ESO Balancing Programme team.
- Detailed project work packages can be found on ENA Smarter portal: here.

Innovation Project: Forecasting the Risk of Congestion

Drivers:

- The increase number of interconnectors connected to GB grid, together with the intermittent nature of renewable energy resources posses various challenges to day ahead operation planning, in particular the forecast of gird congestion.
- Currently various decisions are made within the day to overcome congestions.
- As the number of intermittent sources of energy are connected to the grid there's a need for operational tool to forecast the risk of congestion in probabilistic manner in the day ahead stage.

Scope:

- Develop a machine learning model to forecast interconnectors flow in the day ahead stage.
- Develop a tool tested on a sample of weeks and provide the congestion risk profile for each pair of contingency and critical branches identified.
- Compare results from probabilistic distribution for congestions with existing point forecast, and consider impact on potential operator actions.
- Update overall procedure to include uncertainties from key wind generation units.

Progress:

- Interconnectors flow forecaster has been developed and tested against historical scheduled and outturn flow.
- Explicit day ahead scenarios of interconnectors flow have been generated ready to be interfaced with the grid model for the next stages of the project.
- Detailed project work packages can be found on ENA Smarter portal: here.

Innovation for Balancing

Any Ideas? Please contact us:

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