# Digital twin–based river-system model

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**Abstract:** A digital twin refers to a virtual replica of a physical system, which is created using digital technologies. It provides for the simulation and analysis of the real-world system or product in real-time, leading to a better understanding and optimization of its operation. The use of digital twin technology spans across various industries such as manufacturing, earth science, healthcare, and transportation. Typically, a digital twin consists of three components, namely the physical assets, digital assets, and analytical assets. This technology allows users to gain insights into the behaviour and performance of their physical assets, leading to improved efficiency, cost reduction, and better decision-making.

Our team launched a web-based application named "Northern Australia Water Resource Assessment-river" (NAWRA-river; https://nawra-river.shinyapps.io/river/). The app integrates several models developed as part of the Northern Australia Water Resource Assessment (NAWRA), which can be easily accessed by all stakeholders. This provides transparency in the river system modelling carried out in the assessment and enables users to answer their own questions. The NAWRA-river (Seo et al., 2019) offers several benefits, including real-time modelling, the ability to consider various user interests, and interactive features such as interactive input tables, plots, and maps. However, despite its strengths, the web application still relies on traditional presentation methods, such as graphs, tables, and maps. While these presentation methods may be suitable for reporting and analysis purposes, they have limited capacity for stakeholders to visualise hydrological change in a landscape (e.g., the visual amenity of changes in water level of a potential reservoir).

Our team has expanded the features and utility of the river-system model by importing the river-system model into digital twin technology to enhance the conceptualisation of the real catchment variability. The digital twin version of NAWRA-river is designed to offer an interactive and comprehensive evaluation of the feasibility of water resource development, including the potential impacts on the catchment. Unity is used to build the overall user interface (UI) and virtual reality (VR) and it receives the model configuration that users define for their own interests. The application communicates with the river-system model hosted in a server via R-API (R-Application Programming Interface). The configuration of the model is visualised on the VR interface such as change of the irrigation and dam operation. The model specification is provided to the server, the river-system model simulates the configured river-system and push the feedback toward the application. At the end the application visualises the change along the river system.

The digital twin version of the NAWRA-river consists of numerous natural entities such as terrains, soil, river, water body, vegetation, and irrigation facilities as the form of a digital asset. Terrain is visualised based on a digital elevation map (DEM) to realise the actual catchment. Vegetation is visualised by 3D-mesh model. River spline and water body were visualised by the combination of both WofS (https://data.gov.au/data/dataset/719a5433-2af0-4601-8036-a03f77199442) and DEM.

## REFERENCES

Seo, L., Hughes, J., Petheram, C. and Stratford, D (2019) Development of an interactive river system model based on a web application, MODSIM2019, 23rd International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2019, pp. 457.

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