Bio-inspired search algorithms for design and operation of water supply / distribution systems

To overcome the inherent limitations of conventional optimisation techniques in solving large-scale nonlinear water resource optimisation problems, my research team works on development of bio-inspired search algorithms (such as ant colony optimisation, particle swarm optimisation, honey bee search algorithm, cross entropy algorithm, gravitational search algorithm, genetic algorithms, differential evolution, etc.) for single and multi-objective optimisation, and employing it for planning, design, and operation of water resources systems, such as single and multipurpose reservoir operation; river basin planning, sustainable and / or optimal utilisation of water resources in the basin; multi-objective analysis; parameter estimation of complex hydrological models, etc.

Water distribution networks (WDNs) are one of the most vital infrastructures, related to our day to day life. For satisfactory water supply at different users / demand nodes, it is essential to consider the various factors affecting the performance of WDNs such as breakage of pipes, failure of pumps, and changing demand patterns, etc., which is represented in terms of the reliability of WDNs. Reliability can be assessed for mechanical and hydraulic failures. While mechanical failure comprises of the failure of components such as pipe, pumps, valves, etc., hydraulic failure is due to the uncertainty in nodal demands and changes in pipe roughness. The design of WDNs is thus considered as a multi-objective problem requiring cost minimisation and reliability maximisation. While there are various reliability estimation techniques, these measures are computationally demanding and time consuming.

Our research group is involved in developing modelling tools using evolutionary algorithms for single and multi-objective optimisation; modelling fuzzy-random uncertainty in demands, and investigates alternative approaches / reliability surrogate measures (RSMs) such as entropy, resiliency, network resilience, etc. for performance based design of WDNs.

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