Izquierdo, J.; **Pérez, R.**; **Iglesias, P. L.**
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Summary: The study field of water comprises a large variety of activities and interests, and therefore, areas of work. These areas face real engineering problems and, as a consequence, the contributions by some techniques from applied mathematics are really important. On the one hand, it is necessary to have analysis tools that allow us to carry out reliable simulations of the different models by analyzing different configurations, operation modes, load conditions, etc., in order to study existing installations from their basic characteristic data. They are determinist processes whose mathematical expressions consist of coupled systems of different types of equations, algebraic, ordinary differential, and partial differential equations, typically nonlinear, for which specific numerical techniques are necessary. In addition, given the uncertainty of many of the data (especially in existing configurations), it is frequently necessary to solve important inverse problems where other techniques (statistical, minimum quadratic, etc.) are also highly interesting. On the other hand, design is necessary in order to carry out new configurations. Frequently, the absence of initial data and the need of fulfilling different types of restrictions (some of them prone to subjectivity) turn design processes into real optimization problems where the classical methods frequently fail and for which the most current techniques based on neural networks, genetic algorithms, fuzzy theory, chaos theory, etc. are indispensable. This document describes the most important mathematical aspects needed in some of the stages of the integral cycle of water, with special emphasis on the most current topics.

MSC:

91B76 Environmental economics (natural resource models, harvesting, pollution, etc.)

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