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Abstract In this study, information gap decision theory (IGDT) is reformed to formulate the uncertain parameters of wind power, photovoltaic and load. Traditional IGDT presumes that positive and negative deviations of uncertain parameters of the predicted value are equal, and it would result in imprecise assessment of fluctuated intervals. This study proposes an improved IGDT to overcome the inaccuracy of traditional IGDT by considering unsymmetrical fluctuation levels of uncertainties. For the operation and control of active distribution network, the non-linear power flow constraints are included and linearised with a novel method based on circumscribed polyhedron approximation, which guarantees the accuracy of the solution results and takes less computing time. Additionally, from the mathematical point of view, the model established in this study is a multilevel optimisation problem, and linear Karush–Kuhn–Tucker conditions are formulated to transform the multilevel optimisation problem into a single-level optimisation problem. Finally, the economic viability and model applicability are verified through the modified IEEE 33-node distribution system.