A Novel Hybrid Artificial Intelligence Technique for Colpitts Oscillator Design

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Abstract

In the design of the common base Colpitts oscillator, the resistance values of Thevenin's resistors significantly influenced the transient time and steady state response of the resulting circuit. Various traditional approaches such as intuitive reasoning, mathematical calculation, and simulation-based techniques have been proposed in the literature for this purpose. Some of the aforementioned techniques involve rigorous mathematics, intuition, and experimentation in determining appropriate component values for optimal performance, stable steady state performance, and short transient response time from the resulting oscillator. In this paper, a new method of designing Colpitts oscillator using hybrid artificial intelligence comprising evolutionary-based Genetic Algorithm (GA) and artificial neural network (ANN) has been proposed. GA has been used in selecting various optimum resistance values of Thevenin's resistors for maximizing long-term stability of the output waveform thus ensuring stable steady response of the designed circuit. ANN has been utilized in learning the nonlinear relationship between Thevenin's resistors and transient time response of the Colpitts oscillator. Upon ANN convergence, optimum resistance values of obtained from GA process are fed into the trained ANN in predicting transient response time of each circuit. Optimized values with the shortest transient response time are finally selected for the Colpitts oscillator. The designed circuit successfully achieved optimization between its transient time response and steady state response. Hence, successfully reducing computation associated with existing traditional techniques in designing similar optimum Colpitts oscillator and achieving stable steady state output. Furthermore, this work has also demonstrated that ANN is capable of predicting the transient time of circuit with reasonable accuracy.

Keywords: Artificial neural network (ANN), Colpitts oscillator, Genetic Algorithm (GA), Transient response time

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