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Automatic Design of Fuzzy Logic Controllers for Medium Access Control in Wireless Body Area Networks – an Evolutionary Approach

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Abstract

Soft computing techniques including fuzzy logic have been successfully applied to Wireless Body Area Networks (WBANs). However, most of the existing research works rely on manual design of the Fuzzy Logic Controller (FLC). To address this issue, in this paper, we propose an evolutionary approach to automate the design of FLCs for cross layer medium access control in WBANs. With the goal of improving network reliability while keeping the communication delay at a low level, we have particularly studied the usefulness of three coding schemes with different levels of flexibility during the evolutionary design process. The influence of fitness functions that measure the effectiveness of each possible FLC design has also been examined carefully in order to achieve a good balance between reliability and performance. Moreover, we have utilised surrogate models to improve the efficiency of the design process. In consideration of practical usefulness, we have further identified two main design targets. The first target is to design effective FLCs for a specific network configuration. The second target focuses on designing FLCs to function across a wide range of network settings. In order to examine the usefulness of our design approach, we have utilised two widely used evolutionary algorithms, i.e. Particle Swarm Optimisation (PSO) and Differential Evolution (DE). The FLC designed by our

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