Hybrid system based fuzzy-pid control schemes for unpredictable process

Abstract

In general, the primary aim of polymerization industry is to enhance the process operation in order to obtain high quality and purity product. However, a sudden and large amount of heat will be released rapidly during the mixing process of two reactants, i.e. phenol and formalin due to its exothermic behavior. The unpredictable heat will cause deviation of process temperature and hence affect the quality of the product. Therefore, it is vital to control the process temperature during the polymerization. In the modern industry, fuzzy logic is commonly used to auto-tune PID controller to control the process temperature. However, this method needs an experienced operator to fine tune the fuzzy membership function and universe of discourse via trial and error approach. Hence, the setting of fuzzy inference system might not be accurate due to the human errors. Besides that, control of the process can be challenging due to the rapid changes in the plant parameters which will increase the process complexity. This paper proposes an optimization scheme using hybrid of Qlearning (QL) and genetic algorithm (GA) to optimize the fuzzy membership function in order to allow the conventional fuzzy-PID controller to control the process temperature more effectively. The performances of the proposed optimization scheme are compared with the existing fuzzy-PID scheme. The results show that the proposed optimization scheme is able to control the process temperature more effectively even if disturbance is introduced.