

## **Improved coupled tank liquid levels system based on hybrid genetic-immune adaptive tuning of PI controller**

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### **ABSTRACT**

The accuracy and stability of many systems in chemical and process industries which has Two-Input Two-Output (TITO) is one of the key factors of process which have cross coupling between process input and output. Unlike traditional neural network weight adaptation using gradient descent method, Hybrid Genetic-Immune technique was utilized for adaptive tuning of neural network weights adjustment and fine tuning the controller's parameters. The TITO is modeled in Simulink and the Hybrid GA-AIS algorithm is implemented in MATLAB. The performances of proposed method also compared with GA and Artificial Immune System (AIS) alone, it was shown that hybrid PI-NN hybrid GA-AIS have superior features, stable convergence characteristic and good computational efficiency.

### **KEYWORDS:**

NN; GA; level control; couple tank

## ACKNOWLEDGMENT

This study was supported by Faculty of Electrical and Electronics Engineering, University Malaysia Pahang, under Control and Instrumentation (COINS) Research Group.

## REFERENCES

1. J. Herskovits, P. Mappa, E. Goulart and C.M Mota Soares, "Mathematical programming models and algorithms for engineering design optimization," *Computer Methods in Applied Mechanics and Engineering*, 194 (30), 2005, pp. 3244-3268
2. A.L. Araujo, C.M. MotaSoares, J. Herskovits. and P. Pedersen, "Development of a Finite Element Model for the Identification of Material and Piezoelectric Properties through Gradient Optimization and Experimental Vibration Data". *Composite Structures*, 58, 2002, pp. 307 – 318
3. J.E. Dennis, and R. Schnabel., "Numerical Methods for Constrained Optimization and Nonlinear Equations". New Jersey:Prentice Hall, 1983
4. S.S. Auatt, L.A. Borges, and J. Herskovits, "An Interior Point Optimization Algorithm for Contact Problems in Linear Elasticity". *Numerical Methods in Engineering*, 1996, pp.855-861.
5. Visioli, "A new design for a PID plus feedforward controller". *J. Process Control* 14: 457-463. DOI: [org/10.1016/j.jprocont.2003.09.003](https://doi.org/10.1016/j.jprocont.2003.09.003)\%20.

