Green-Directed Modular Analysis for Product Design

;

E-mail: 9423701@ mail.dyu.edu.tw

ABSTRACT

To respond market competition, an enterprise must produce enough differentiation in products to meet the consumer's demands. Large amount parts and modules are stocked to satisfy different market changes. The frequent variations of inventory will cause the complexity in management due to the associating and separating between modules. Therefore, how to bring the complexity and accuracy of product modularity into control has become one of the important challenges enterprises have to face nowadays. In dealing with modular design, designer almost arranges the plan depending on his/her intuition. In this study, a quantitative assessing approach for modular design is proposed. First, this research attempts to develop a fuzzy linguistic-based method incorporating grouping genetic algorithm (GGA) to produce the initial modules of the product. Many viewpoints such as contact type, combined type, tool, and assessed direction among parts are discussed in this study. Secondly, green-oriented concept is used to access the rationality among modules. The low polluted materials are suggested to improve product modularity. Finally, C++ programming language and some test examples are used to simulate and verify this proposed method.

Keywords : Modularity ; Grouping genetic algorithm ; fuzzy linguistic number

Table of Contents

REFERENCES

[1]Jiao, J., Tseng, M.M., " A methodology of developing product family architecture for mass customization," Journal of Intelligent Manufacturing, vol.10, pp.3-20 (1999).

[2]Qian, X., and Zhang H.C., " Design for environment: An environmental analysis model for the modular design of products," IEEE International Symposium, pp.114-119 (2003).

[3]De Fazio, D.F. and Whitney, D.E., " Simplified generation of all mechanical assembly sequences," IEEE Journal of Robotics and Automations, vol.3, No.6, pp.640-658, (1987).

[4]Gu, P., and Sosale, S., " Product modularization for life cycle engineering," Robotics and Computer Integrated Manufacturing, vol.15, pp.387-401 (1999).

[5]Otto, K., and Wood, K., Product Design, Prentice Hall (2001).

[6]Cohen, L., Quality Function Deployment:How to make QFD work for you, Addison-Wesley Publishing Company, New York (1955).

[7]Juliana, " Modularity and Interface Management for Product Architectures," Copenhagen Business School, IVS, Howitzvej 60, DK-2000 Frederiksberg, Denmark, pp599-609.

[8]Sand, J.C., Gu, P., and Watson, G., " HOME: House of Modular Enhancement a tool for modular product redesign," Concurrent engineering: research and applications, vol.10, no.2 (2002).

[9]Huang, C. C.," A Multi-agent approach to collaborative design of modular products," Concurrent engineering: research and applications, vol.12, no.1, pp.39-47 (2004).

[10]Kusiak, A., and Huang,C. C., " Develop of Modular Products," IEEE Transactions on Components Packing and Manufacturing Technology, vol.19, no.4, pp.523-538 (1996).

[11]HE, D.W. and Kusiak, A., " Performance analysis of modular products," International Journal Production Research, vol.34, no.1,

pp.253-272 (1996).

[12]Kahoo, L. P., and Situmdrang, T.D., " Solving the assembly configuration problem for modular products using immune algorithm approach, " International Journal Production Research, vol.41, no.15, pp.3419-3434 (2003).

[13]Yigit, A. S., and Allahverdi A., " Optimal selection of module instances for modular products in reconfigurable manufacturing systems," International Journal Production Research, vol.41, no.17, pp.4063-4074 (2003).

[14]Gu, P., Hashemian, M., Sosale, S., " An integrated modular design methodology for life-cycle engineering," Annals for CIRP, vol.46, pp.71-74 (1997).

[15]Newcomb, P. J., Bras, B., and Rosen, D. W., " Implications of modularity on product design for the life cycle," Transaction of the ASME, vol.120, pp.483-490. (1998) [16]Falkenaur, E., " The grouping genetic algorithms-widening the scope of GAs", JORBEL-Belgian Journal of Operation Research, Statistics and Computer Science, vol.33, pp.77-102 (1992).

[17]Yen J. and L. Reaz, Fuzzy Logic:Intelligence, Control, and Information, Prentice-Hall, Inc 1999 .

[18]Pahl, G., and Beitz, W., Engineering Design:A Systematic Approach, 2nd edition, Spring-Verlag. London (1996).

[19]Falkenaur, E., Genetic algorithms for grouping problem. New York, Wiley (1998).

[20]Buckley, J.J., " Ranking alternatives using fuzzy numbers", Fuzzy Sets and Systems, vol.15, pp.21-31.(1985) [21]Chen, S. J. and Hwang. C. L., Fuzzy Multiple Attribute Decision Making Methods and Applications, Springer-Verlag, Berlin Heidelberg 1992 .

[22]Falkenaur, E., " A new representation and operators for genetic algorithms applied to grouping problems", Evolutionary Computation, 2(2), 123-144.(1994) [23]Rekiek,. B., Falkenauer, E. and Delchambra, A., " Multiple-product resource planning," Proceeding of the IEEE international Symposium on Assembly and Task Planning (1997).

[24]Kreng, V.B., and Lee, T.P., " Modular product design with grouping genetic algorithm – a case study," Computer & Industry Engineering, vol.46, pp.443-460 (2004).

[25]Goldberg. D., Genetic Algorithms in Search, Optimization and Machine Learning. Addison – Wesley (1989).

[26]Ericsson, A., and Erixon, G., Controlling Design Variants: Modular Product Platforms, ASME Press (1999).

[27]Eco-indicator 99. Source: web site: www.pre.nl [28]Nevins and Whitney, D.E., " A Strategy for the next generation in manufacturing," Concurrent design of product & process, New York:McGraw-Hill(1989). : [29] Fuzzy (2001).

[30] (1995).

[31] http://www.cla.gov.tw/