Proc. of the 9th Intl. Conf. of Asian Society for Precision Engg. and Nanotechnology (ASPEN 2022)
15–18 November 2022, Singapore. Edited by Nai Mui Ling Sharon and A. Senthil Kumar
doi://10.3850/978-981-18-6021-8_OR-18-0310

Optimal Allocation of Random Grouped Assembly for Three-Dimensional Precision

Wen-Che Chang[1] and Jhy-Cherng Tsai[1,#]

[1]Department of Mechanical Engineering, National Chung-Hsing University, 145 Xingda Rd., Taichung City 40227, Taiwan
Corresponding Author / Email: jctsai@nchu.edu.tw, TEL: +886-4-2284-0433, FAX: +886-4-2287-7170

KEYWORDS: Assembly Precision, Error Stack-up, Grouped Random Assembly, Genetic Algorithm

---

Precision is one of the most critical indices of a precise product. Grouped random assembly (GRA) has been proposed to achieve higher precision for batch production[]. GRA is a method that divides components, with tolerance sorted, into serval groups. Components in each group are then randomly assembled with other components in corresponding group so that higher precision can be achieved. While current GRA deals with one-dimensional dimensional chain, this paper investigates optimal grouping, in terms of best three-dimensional (3D) precision, for assembly of multiple componets. As there are many combinations of matching groups in GRA, we started with minimum groups of components, whose dimensions were sorted. Allocation of matching groups of different components are then optimized by the Genetic Algorithm (GA). If the resultant precision is not satisfied, groups of parts are further increased to improve the resultant precision. The illustrated assembly example of a dual-axis rotary table, with 100 components for each part, showed that 3D errors can be reduced from 19.4% to 51.9%, compared with that assembled without grouping, by four-group GRA. The corresponding yield rate thus increases from 77% to 94% without rework. The yield rate can be further increased to 100% with 20-group GRA. The merit of this approach is to achieve high 3D precision for multiple part assembly without modification or rework of componets.