



マクロ視点による構想段階における デジタル印刷機のシミュレーション設計

Design of a Digital Printer by Macroscopic Simulation in the Conceptual Design Stage

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This research project is an application of quality engineering to the overall system design of a digital printer, as proposed by Genichi Taguchi in 2006. At the time, the companies to which the proposal was made opposed it because the number of experimental variables was too large to evaluate on a prototype printer. The idea in the present project was to carry out Taguchi's proposal by simulation and attempt to optimize the design in the conceptual design stage, before prototyping. In the development of digital printers in the past, individual optimization was the rule: first the component technologies were developed for each subunit; then they were combined and optimally adjusted, at the expenditure of much labor. In the macroscopic approach taken here, control factors were selected for the entire system so as to cover each subunit, the selected control factors were assigned to an L_{36} orthogonal array, and simulation was carried out. Noise factors were also assigned to an L_{12} orthogonal array in consideration of variability of components and assembly procedures used in the production process and environmental variations in the field. Reproducibility of the optimum conditions thus obtained was confirmed in a confirmation experiment. The economic benefit, when converted from the benefit of shortening the design study time, was estimated to be at least 218 million yen. The present project showed that it was possible to confirm overall system robustness from the conceptual design stage without a prototype printer, and to design-in quality earlier than in the past.

Key words : Taguchi methods, robust quality engineering, simulation, S/N ratio, orthogonal arrays, factorial effect, robust design, electrophotographic process, imaging quality

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