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A Two-Stage Taguchi Design Example–Image Quality Promotion in Miniature Camera/Cell-Phone Lens

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Abstract

A simple, practical manufacturing process, integrating manufacturing capability-oriented design (MCOD) philosophy and Taguchi's method, is presented to tackle the high resolution miniature camera/cell phone lens issues at the manufacturing phase. Meanwhile, we also use optical software to create an analytical simulation model to investigate the quality characteristics due to lens' thickness, eccentricity, surface profile, and air lens' gap; a single quality characteristics expressed in terms of modulation transfer function (MTF) is defined. Optimal combination of process parameters in experimental scenario using Taguchi's method is performed, and the results are judged and analyzed by the indices of signal-to-noise ratio (S/N) and the analysis of variance (ANOVA). The key idea of the two-stage design is to utilize optical software to conduct the sensitivity analysis of MTF first; an analytical model, dependent on actual process parameters at manufacturing stage, is constructed next; and finally by substituting these outputs from the analytical model back to the optical software to verify the design criterion and do the modifications. By minimizing both the theoretical errors at design stage and the complexity in the manufacturing process, we are able to seeking for the most economical solution, simultaneously attain the optimal/suboptimal combination of process parameters or control factors in lens manufacturing issue.

Keywords: Taguchi Method, MTF, Lens

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