Automatic Optical Inspection of Microdrill Bits in Printed Circuit Board Manufacturing

段桂芳

Automatic inspection of microdrill bits has become a matter of great importance for quality control in Printed Circuit Board (PCB) production with the rapid expandition of PCB manufacturing industry. For microdrill bits with a diameter of several hundred micro millimeters, it is obviously impossible to satisfy the requirement by human visual inspection. Automatic optical inspection (AOI) methods using machine vision techniques has been shown to be a promising way for microdrill bits inspection. It relieves inspectors of the tedious jobs. Compared to manual inspection, it is time-saving, objective and non-contact. Conventional AOI systems for microdrill bits always adopt the strategy of "one-to-one" comparison. Geometric quantities are measured to compare with prior standards for micro drill bits inspection. However, to guarantee measurement accuracy, the inspection instrument requires a large enlargement lens and high resolution CCD. It increases the cost of both system hardware and system computation. In this thesis, we focus on the research of developing novel AOI methods for microdrill bits that lowers the requirement for imaging equipment of the inspection instrument. A pattern recognition based scheme was devised to accomplish the objective. The index of phase was defined and served as an organizing theme from which the effect of various identification methods was investigated. The major contribution of our work can be summarized as follows:

1. An optical system for inspecting microdrill bits has been developed. Compared to conventional systems, it can not only achieve high speed and precision, but can also identify the phases for microdrill bits inspection. We quantify the experience of inspectors by learning the geometric features from training sets, and build a database for saving the 'experience', which has been served for microdrill bit inspection.
2. A statistical shape model based method was proposed for automatic optical phase identification of microdrill bits. The shape of microdrill bits can be represented by the model parameters. It is easy to extract the features, so the inspection speed was improved. In addition, based on the statistical shape model, an improved active shape model (ASM) based method was proposed for automatic optical phase identification of microdrill bits, which is free from alignment and segmentation.
3. The developed AOI system of microdrill bits has been commercialized. It gives a proof that our developed AOI system is practical and has a good prospect to be widely used.