

TSS 1ST SINGAPORE ENGINEERING DESIGN CHALLENGE 2005—Third Prize

Many modern manufacturing processes require precision machines, a large proportion of which requiring the accurate positioning of some sort of tools or probes with respect to a workpiece. Thus, the challenges in the technology behind machine tools and measuring machine metrology are concerned with the accurate measurement of this absolute position and the subsequent reduction of errors in this position. The earlier generation of compensation methods mainly utilized mechanical correctors (in the form of leadscrew correctors, cams, reference straightedges etc). Compensation via mechanical correction, however, inevitably increases the complexity of the physical machine. Furthermore, mechanical corrections rapidly cease to be effective due to mechanical wear and tear. The corrective components have to be serviced or replaced on a regular basis, all contributing to higher machine downtime and costs.

ECE student **Chian Poh Choon** (working alongside Associate Prof Tan Kok Kiong, Dr. Huang Sunan and Prof. Lee Tong Heng) pioneered a soft compensation approach using neural networks (NNs) for the modeling of the geometrical errors. A function block for geometrical error compensation which can be applied within the MATLAB/SIMULINK control environment has been developed. Specifically, it involves the design of an S-function where the S-function can be generated automatically using M file and Graphical User Interface Tool. The prototype Compensation S-Function Generator (CSFG) requires only the raw calibration data obtained from a laser interferometer system, as well as simple user specifications relating to the desired approximation accuracy. The S-function block is composed of neural networks which are trained to approximate the geometrical error characteristics of a machine, thus dispensing with the need for a look-up table. Since different machines will inevitably inherit different characteristics, the design of the S-function is a dynamic one, based specifically on the machine under consideration. While the present approach relates specifically to the Hewlett Packard (HP) series of interferometers, specific device drivers can be designed to facilitate the input of calibration data from a wide variety of calibration systems available today.

Mr Chian Poh Choon won the third prize (\$1500 and trophy) at Techsource System Engineering Design Competition 2005.