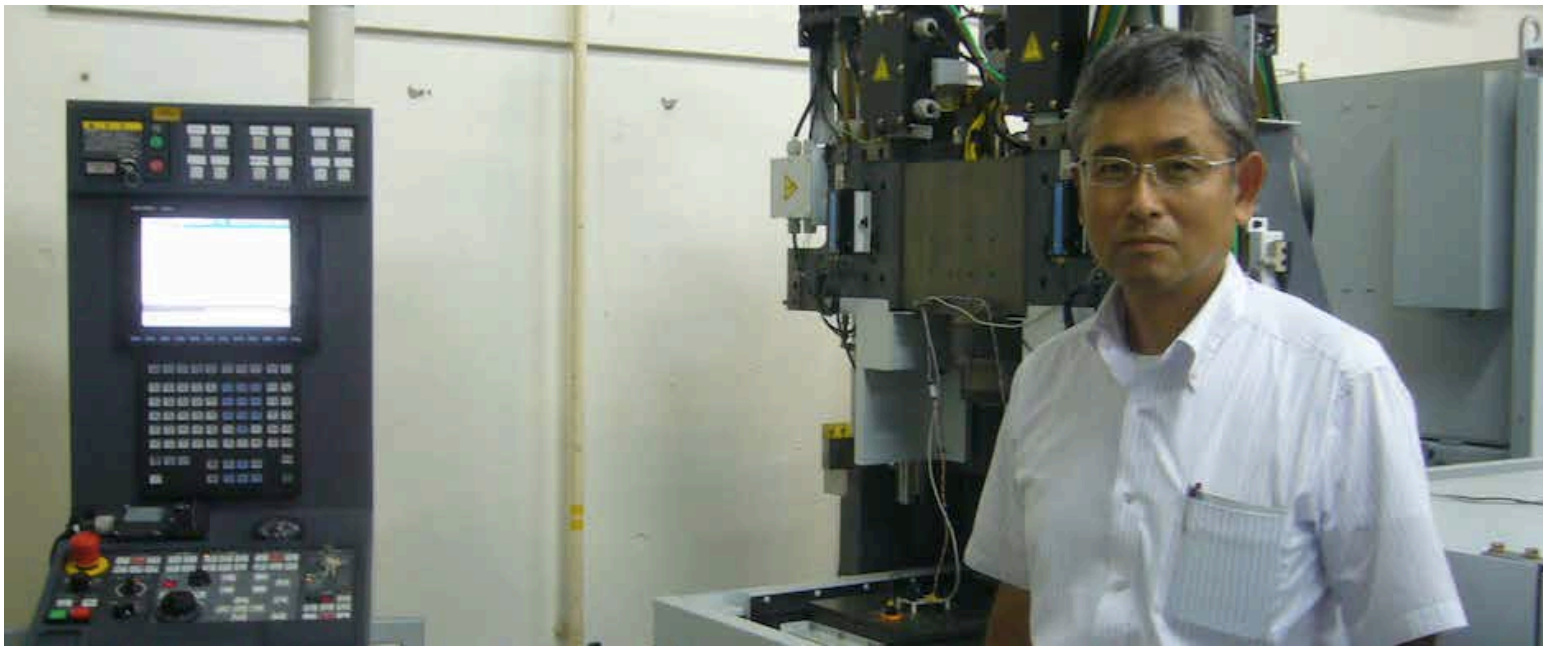
Toyohashi University of Technology



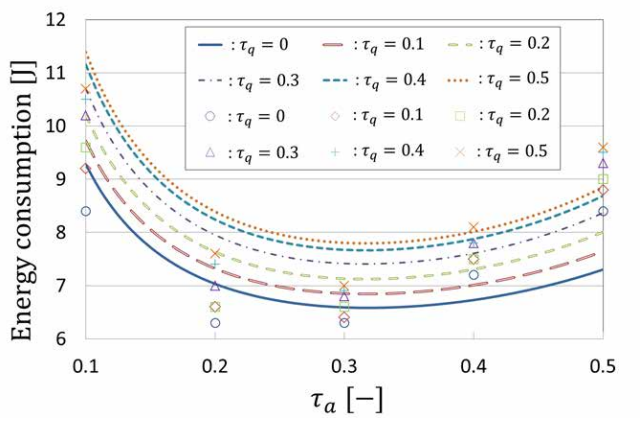
We conduct a study on high accuracy and energy saving control for contouring and point to point motion of industrial machines. We highly appreciate the loaned equipment from MTTRF to verify the effectiveness of our proposed approach. MTTRF equipment also provides good experience for our students to learn industrial machines.

RESEARCH

High Precision and Energy Saving Control of Machine Tool Systems

Machine tool systems are widely used in manufacturing factories around the clock all over the world, and therefore not only high-speed and high-precision operation but also reduced energy consumption is required from the viewpoint of earth environmental and energy shortage problems.

Although hardware improvement of machine tools such as reducing weight of component parts and changing actuators is important for reduced energy consumption, this approach is difficult to be applied to existing machine tools that are already installed in industries. Hence, this study considers a software approach that may be implemented in industrial systems currently in use.



Consumed electricity in point to point control for motions before and after machining using an S-curve trajectory with a combination of linear and quadratic functions was analyzed in the previous years. Although the proposed approach was able to predict energy consumption accurately and achieved to reduce it significantly, precise identification of dynamics parameters was required to generate optimal point to point motion. Hence, we are currently considering new equations for reducing effort on identification of dynamics parameters.

In addition, a contouring controller for reducing energy consumption while maintaining the motion accuracy of machine tool systems was developed. Because it is generally difficult to change feedback control systems in machine tools currently in use, we

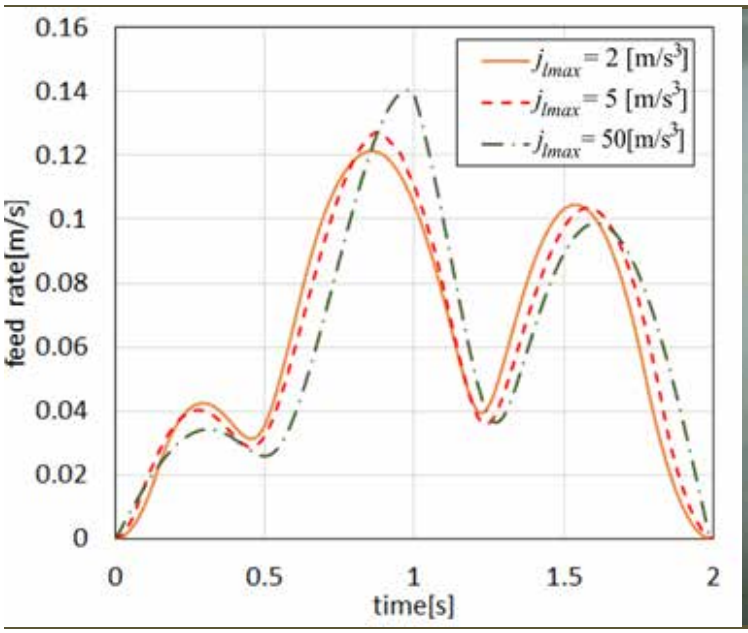
are developing a new contouring controller based on feed forward control, which allows the implementation by changing NC codes. This controller can typically improve the contouring performance from information on control input and tracking errors in the previous cycle operation by changing next control input.

EDUCATION

Control of Servo Motor
(Undergraduate course)

This course is a hands-on subject in which students learn physical properties of a motor, mechanism of a motor driver, construction of control system, fundamentals of control theory such as PID control and pole placement control, application of control theory to a motor, and implementation of control programs in a discrete-time form. Students learn how NC codes are implemented and feed drive motion is demonstrated with the MTTRF equipment under several different trajectories.

In this course, we provide a motor driver by which we can implement arbitrary control programs. Fundamental PID control, which is widely used in industrial applications, is explained. PID controller gains are determined by a pole placement method. Students can learn dynamics of drive systems and how control system poles affect the motion performance of industrial machines. Before designing the control system, they can learn how to identify dynamics parameters of drive systems. Then, they design a PID control system with identified dynamics parameters. After conducting simulation study under several PID control gains, students apply a controller that is expected to provide the best performance to a real drive system.



Naoki Uchiyama
Professor
Department of Mechanical Engineering
Toyohashi University of Technology (Japan)

Lab Website: http://ise.me.tut.ac.jp/index-e.html

MTTRF Awardee since 2013