DEPARTMENT OF MECHANICAL ENGINEERING
Purdue School of Engineering and Technology

SPRING 2004 SEMINAR SERIES

Date: Friday, March 12, 2004
Time: 1:00 pm - 2:00 pm
Room: SL 223

Everyone is invited

DESIGN AND ANALYSIS OF A COMPLIANT GRASPER FOR HANDLING LIVE OBJECTS

Dr. Xuecheng Yin

Abstract. This seminar presents the development of a model for analyzing the design of an automated live-bird transfer system (LBTS) developed at Georgia Tech. One of the most fundamental tasks in the automated transferring is to design and control a grasping system that is capable of accommodating a specified range of objects without causing damage. However, unlike grasping in robotic research that focuses on dexterous manipulation of a single object, repetitive transfer of live objects in a production line requires continuous grasping at high-speed.

This research investigates the use of rotating fingers (capable of undergoing large deflections) to cradle live birds on a moving conveyor for subsequent handling. As compared to fingers with multiple active joints, flexible fingers have many merits, for they are lightweight and have no relative individually moving parts. Their ability to accommodate a limited range of varying sizes, shapes, and the natural reactions of some objects make rubber fingers an attractive candidate for use as graspers in a high-speed production setting. In order to reduce the number of birds and hardware/software design configurations to be tested, a good understanding of the object dynamics throughout the grasping process is necessary. A quasi-static model has been developed for predicting the contact force between a moving object and a rotating finger. The model has been validated with the experimentally measured data and the computed results using finite element (FE) methods. Finally, an illustrative application of the validated model has been demonstrated in the design of a rotating hand used in the automated LBTS. The orientation of the bird in the LBTS is determined using neural network method, and the grasping dynamics of the object are verified through image sequence analysis.

The analytical model provides a rational basis for predicting the contact forces, optimizing the design of the grasping system, and developing a controller for a high-speed transfer system. It is expected that the analysis presented here can be readily extended to other dynamic systems involving the use of flexible beams.