Public Abstract
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Mechanical and Thermal Buckling of Thin Films
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Devices with feature size on the order of one micrometer have found widespread applications in science and engineering. MEMS, is a rapidly growing technology for the fabrication of miniature devices which provides a way to integrate mechanical, fluidic, optical, and electronic functionality on very small devices, ranging from 0.1 microns to one millimeter. Recently, it has been proposed that regular patterns can be generated through the mechanical buckling of a thin film.

In this thesis, we focus on the buckling mechanism. The wavy patterns are generated when the thin elastic film is subjected to an in-plane compressive stress and by the application of controlled heating. We first introduce the mechanism of developing wave patterns through buckling using beam buckling as an example and then the finite element formulation and the commercial analysis package Algor. Our study includes the “stress stiffening” component, which is not usually included in most finite element analyses. Both the ‘Critical Buckling Load and the ‘Natural Frequency with Load Stiffening’ analyses are made use of to determine the buckling loads. Finally, the buckling load for each case is determined through the analysis and a comparison with the theoretical values is made.