INTERNATIONAL CENTRE OF EXCELLENCE FOR EDUCATION IN MATHEMATICS

Variational principles applied in film blowing

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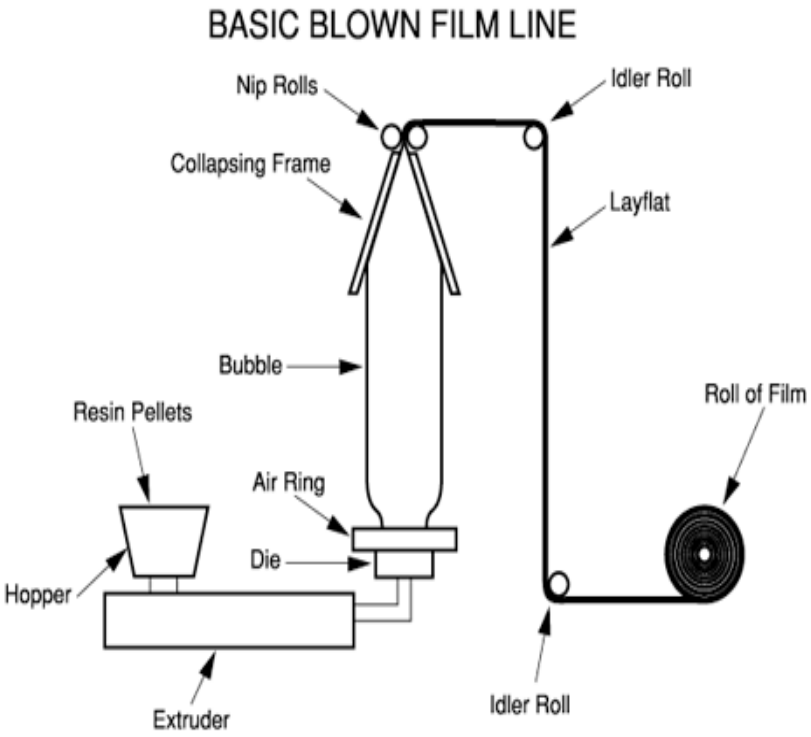
In December 2006 scholarships were handed out to several students of the Mathematics department. Having been fortunate enough to be among the recipients, it was decided that the work completed over the six weeks designated would form the basis for Honors project 2007. Prior to the 2006 November examinations, we observed that the topic of Film-Blowing could possibly provide with some interesting mathematical problems and findings. The work presented in Sydney was based primarily on the Martin Zatloukal's 'Modeling of the film blowing process by using variational principles', a Czech-based paper provided by supervisor John Shepherd. Now, the tubular blown film extrusion process is used extensively to produce thin polymer films. In this process, the polymer melt is extruded through an annular die forming a continuous tube. Once this is achieved the tube (moving upward and collected at nip rolls) is inflated and stretched by the air that is pumped into it, thus creating the bubble. The bubble, moving upward and collected at nip rolls, is then cooled by an air jet, which flows from a ring toward its surface. Variational principles are then employed to formulate a model for the shape of the bubble produced, whilst attempting to satisfy minimal energy constraints. Many factors influence this shape and they include machine design, materials used and various stress factors. These were not taken into account during the scholarship period due to time constraints, however these may be considered during honors year. A solution satisfying boundary conditions is obtained, however it was found that the plot representing this varied greatly with even slight alterations to the parameters defining the bubble shape. This points to a few possibilities, including the need to introduce extra parameters or other boundary condition(s).

Diagram: The Film-Blowing process



Joshua received an ICE-EM Vacation Scholarship in December 2006.
See http://www.ice-em.org.au/students.html#scholarships2007

On Thursday February 15, my colleagues and I arrived in Sydney for the Big Day In. This provided us with the opportunity to mingle with CSIRO members and scholars from around the country, and to present to these people the results of our research scholarships. As stated earlier, I was presented with the offer in December of last year. Initially, I was hesitant to accept this offer, although I saw it as an opportunity to increase my competence in mathematics. The main reasons behind this uncertainty were lack of experience with project work and previous results. Although the results obtained last year were reasonable (average of 70), they could have been better. Thanks to John and fellow professor Bill Blyth, who both convinced me that I was capable of carrying out this work and delivering a presentation at the Big Day In, I will now go into honors 2007 with renewed confidence and determination. I also look forward to taking the film-blowing problem further as there are more aspects of this to be taken into consideration.

Having successfully delivered a presentation on the Film-blowing process, the choice of topic for the Honors project (30% of total assessment) is logical. One of the many advantages of carrying out work on a summer project is that it can provide the scholarship holder with an early start to his/her project, particularly if they intend on completing an honors year or a doctorate. After some initial hesitation, the scholarship work carried out has helped to affirm my decision to continue with studies in Mathematics in 2007.