NATIONAL UNIVERSITY OF SINGAPORE

School of Computing

PH.D DEFENCE - PUBLIC SEMINAR

Title: **Automated Pop-up Design: Approximating Shape and Motion**

Speaker: Mr Conrado Del Rosario Ruiz Jr

Date/Time: 20 July 2015, Monday, 10:00 AM to 11:30 AM

Venue: Executive Classroom, COM2-04-02

Supervisor : Dr Low Kok Lim, Senior Lecturer, School of Computing

Abstract:

Paper pop-ups are interesting three-dimensional books that fascinate people of all ages. The design and construction of these pop-up books however are generally done by hand and given the lack of expertise in this area has necessitated the need for computer-automated or -assisted tools in designing paper pop-ups. Pop-up design is usually centered on two qualities, namely three-dimensionality and movement. In this thesis, we consider both aspects in our automated design. Previous computational methods have only focused on single-style pop-ups, where each is made of one type of pop-up mechanism. This dissertation explores the facets of the problem for the automated design of multi-style paper pop-ups. In addition, we also consider movement, which has not been the focus of any previous work.

First, we conduct a geometric study of the valid configurations of the paper patches to obtain the conditions for the foldability and stability of pop-up structures. Second, we study the motion of the patches during the folding process, which artist take advantage of to create pop-ups with some form of animation. We then propose a method for approximating the shape of an input mesh using paper pop-ups. Our method abstracts a 3D model by fitting primitive shapes that both closely approximate the input model and facilitate the formation of the pop-up mechanisms. Each shape is then abstracted using a set of 2D patches that combine to form a valid pop-up that is supported by our formulations.

We also propose an approach to reproduce the motion of 3D articulated characters. We map each of the linkage chains of an articulated figure to a specific pop-up mechanism based on the type of motion it can produce. We then obtain the initial values of the parameters of the mechanisms, based on our formulations and parameter estimation. Subsequently, we utilize simulated annealing to search for a plausible layout from a valid configuration space. Our main goal is to propose a framework to support the automated design of multi-style animated

paper pop-ups.