APPLIED DYNAMICAL SYSTEMS SEMINAR

Mathematical modeling of bistable liquid crystal display design

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Liquid Crystal Display (LCD) devices rely on the fact that the molecules of a nematic liquid crystal have the ability to rotate the plane of polarized light, so that when placed between crossed polarizers, light may pass through the liquid crystal layer. The amount of light transmitted depends on the orientation of the molecules within the layer, which in turn can be controlled by application of an electric field. Recently, much effort has been put into the search for bistable LCD devices, in which the director field (which represents the local average direction of the long axis of the nematic liquid crystal molecules) has two optically-distinct configurations that are both stable in the absence of an applied electric field. Such a device is potentially very useful in applications such as electronic paper (two optically-distinct states being, of course, the minimum number required to create a meaningful display with contrast). Once in one of the stable configurations, the device will maintain that configuration until disturbed from it by the application of an electric field. Most LCD devices currently in use rely on a continuous power source to maintain the desired optical effect, and hence bistability offers greatly reduced power consumption. There are challenges to creating a viable device however: firstly, one must design a cell that allows for bistable solutions, but secondly, one has to be able to switch - both ways, and quickly - between the two configurations, by applying an electric field. We propose one possible bistable device that relies on the flexoelectric effect to switch between the stable states, and discuss its feasibility.