# Experiment 5

# Chaotic Rhythms of a Dripping Faucet

## 5.1 Introduction

Undergraduate students are seldom if ever exposed to the fascinating field of nonlinear dynamics. The reason is that th etopic is exceedingly complex from a theoretical standpoint. However, nonlinear dynamics is very prevalent in nature, and can arise from even the simplest of systems. Therefore, the following study of chaotic rhythms of a dripping faucet has been implemented for the purpose of introducing nonlinear dynamics at an undergraduate level.

Since this experiment has been modelled after a very thorough *Computers in Physics* article by Calahan, Leidecker and Calahan, the student will be referred directly to that paper for guidance in this experiment. However, a few notable modifications have been made to simplify the apparatus.

Rather than using the series of 4 litre reservoirs suggested by Calahan and coworkers, we have opted for a single 80 gallon tank. The large tank provides more stable flow rates over long periods of time and it is convenient to fill up with a large volume of water at the beginning of a session and to run continuously.

The most significant deviation from the design of Calahan *et al* is in the timing circuitry. Figure 2 of the abovementioned article shows a circuit centred around a 555 timing chip — a device which has become quite outdated. The circuit in our apparatus uses a much more direct approach; the drops pass through a phototransistor and the resultant electrical pulse activates a Schmidt trigger. Finally, the signal from the Schmidt trigger passes through a one-shot multivibrator to produce a digital pulse that can be read by the PC. The circuit elements have been laid out on a large breadboard so that the student may probe the circuit using an oscilloscope, and the circuit descriptions should be available.

## 5.2 Reference

R.F. Calahan, H. Leidecker and G.D. Calahan, Computers in Physics **4** (4) 368 (1990).