

Testing fish freshness by using a mechanical probe

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1 Introduction

A method for testing fish freshness is illustrated in Figure 1. It comprises a thin needle-like probe

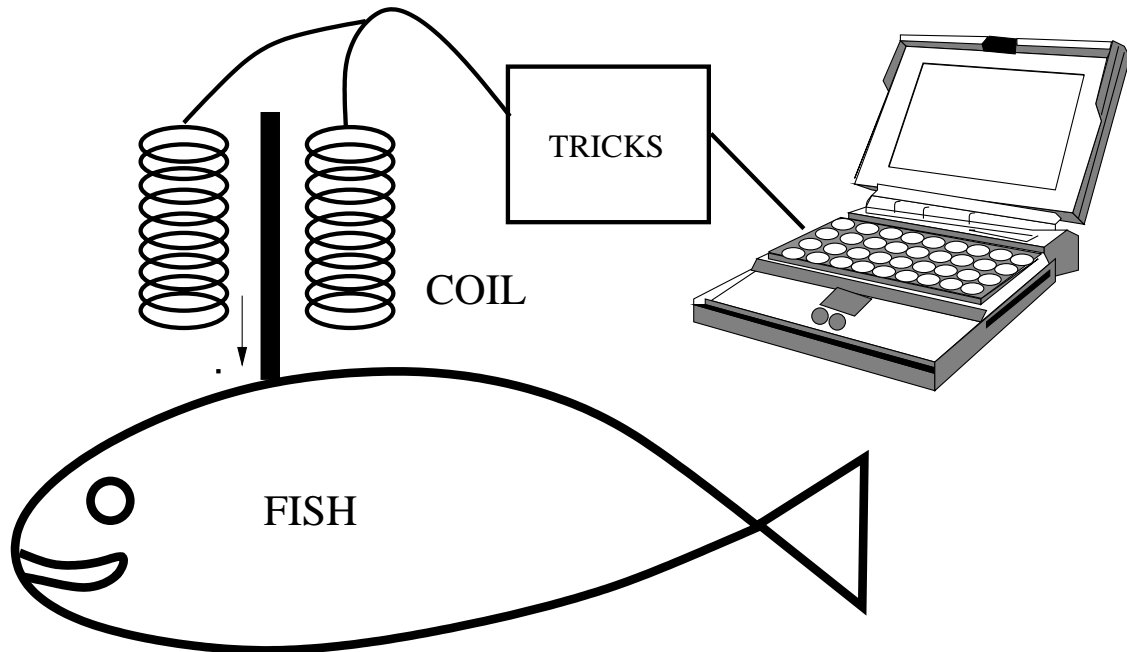


Figure 1: The experimental set-up.

enclosed within a case in which there is a coil. This coil acts both to give an electromagnetic force to the probe and also to measure the motion of the probe. Measurements from the coil can be recorded electronically and used for later analysis. The operation of the probe is as follows. The whole device is placed upon a fish so that the needle comes to rest on the skin of the fish under the force of gravity alone. A constant force F is then applied to the needle by passing a current through the coil. This force causes the probe to move toward the fish, depressing but not piercing the skin. The resulting motion of the probe can then be monitored over the time interval (in milliseconds) that it takes to reach equilibrium. In this time interval the initial motion is elastic (due to the behaviour of the skin of the fish) and later motion is governed by visco-elastic forces and is dominated by the motion of the fluid inside the fish. After the needle has reached equilibrium the force F is suddenly released. The needle then moves upwards as the skin of the fish and the fluid within the fish returns to its unperturbed state. The resulting motion is then monitored. It is unclear whether during this motion the needle always stays in contact with the skin of the fish, or whether it loses contact and starts to move in free fall.

The response of the probe has the form shown in Figure 2. It comprises three main phases of evolution:

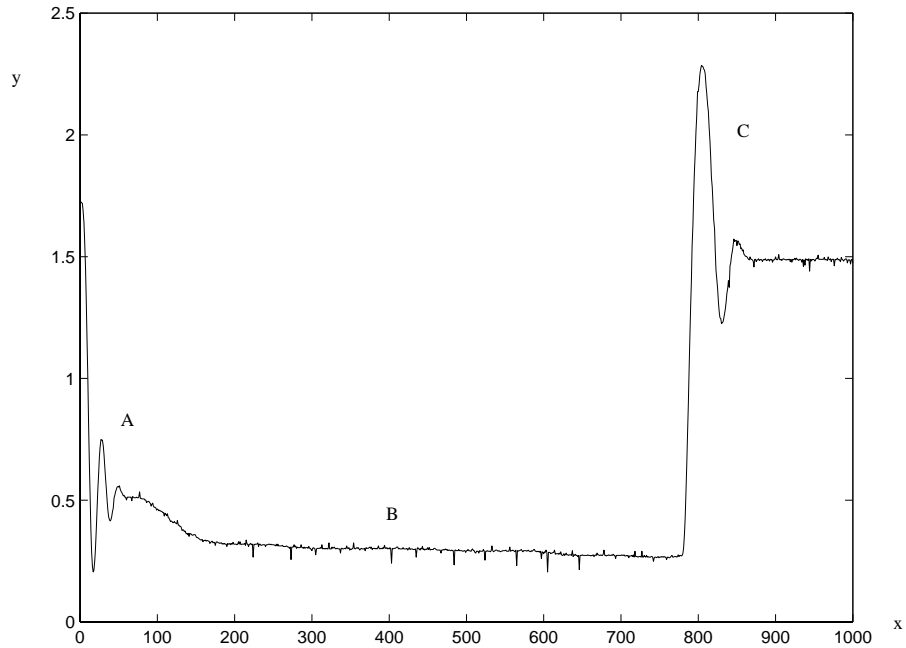


Figure 2: A typical graph produced by the probe: transducer output voltage against time. Here time is in ms and the y axis is in volts.

- A** Initial motion into the skin.
- B** Later motion as fluid is displaced.
- C** Final motion when the force is released.

Each of these responses gives information about the composition of the fish. The basic questions for our workshop are:

1. What information (fish dependent constants) can be extracted from the probe data?
2. How reliable are these measurements? Do they depend upon where on the fish the measurements are made, how firmly the probe is held, how sticky the fish skin is?
3. What, if anything, can the measurements tell us about freshness?