How Loop Detectors Work

A frequently asked question in the newsgroups is about how the vehicle detectors used in traffic lights and in car parks work. The author designed such a detector too many years ago for comfort, and has frequently posted replies to these questions.

Here is one of those replies. It is not a definitive treatment of the subject, but should give you an overview of how loop detectors work.

When you approach a traffic signal or car park boom gate, you may notice a rectangular "scar" where the road surface has been cut with a saw and then re-sealed. This is the sensor loop. The loop consists of several turns or wire buried in the roadway, and connected to an electronic circuit which can detect a car passing over it. Normally the loop is about 1m x 1.5m in size.

How do the electronics detect the passage of the vehicle over the loop? There are three methods I know of:

Dual Channel loop detector for auto gate control.

The loop is part of an oscillator circuit. The oscillator is held just on the verge of oscillation via AGC. When a car enters the loop it "dampens" the loop by absorbing energy, and the oscillation decreases or stops entirely. The circuit needs a very long time constant in the AGC loop in order to detect slowly moving

vehicles, because whatever time constant you start out with is reduced by a factor equal to the effective loop gain of the AGC.

Eagle Signals had a product of this type in the '60's. It used a partially charged NiCd battery as a huge capacitor to get the long time constant required.

The main disadvantage is that every loop will have a slightly different natural frequency of oscillation, and the interactions between adjacent loops are nasty due to beat frequencies (imagine a straight-through lane right next to a slip (green arrow) lane).

A fixed frequency oscillator and driver drives the loop from a high drive source impedance. When a car enters the loop the loop voltage drops by a very small percentage. The drop is detected. The circuit requires an differentiator/amplifier

	which can pick up loop voltage changes as low as .5% with a time constant of several seconds. I designed such a product in the late '60's which was used for 15 years in Western Australia. It had much less interaction between adjacent loops than design #1.
"Ringing Coil"	(I am only guessing on this one, from the odd thing I've heard). A microprocessor "pings" the loop with a short pulse then evaluates the amount of ringing. This will vary depending on the damping in the loop. This would have the advantage of not being restricted by the comparatively short time constants you must live with in analog designs, so the detection of slow moving and even stationary vehicles would be easier.