# Speed detection of moving vehicles using doppler effect essay

Although there is good road safety performance the number of people killed and injured on our roads remain unacceptably high. So the roads safety strategy was published or introduced to support the new casualty reduction targets. The road safety strategy includes all forms of invention based on the engineering, education and enforcement and recognizes that there are many different factors that lead to traffic collisions and casualties. The main reason is speed of vehicle. We use traffic lights and other traffic manager to reduce the speed.

One among them is speed cameras. Speed cameras on the side of urban and rural roads, usually placed to catch transgressors of the stipulated speed limit for that road. The speed cameras are there solely to identify and prosecute those drivers that pass by the them who exceed the stipulated speed limit. So speed limits are good idea. To enforce these speed limit, laws have been passed making speed an offence and signs have been erected so as to indicate the maximum permissible speed. The police can’t be every where to enforce the speed limit and so enforcement cameras are there to do this work.

Nearly everyone slows down infront of the speed Camera. We finally have a solution to the speeding problem. Now if we are to assume that speed cameras are the only way to make driver’s slowdown, and they work efficiently, then we would expect there to be a great number of these every were and that day would be highly visible and identifiable to make drivers slow down. Speed cameras are invariably hidden behind trees, road signs and often the first indication that one is passing through a speed camera

point are the ruler marks painted on the carriageway or flash of the camera when it goes off.

Speed cameras were introduced in west London in 1992 and following their success in reducing speed related crashes and injuries their use expanded to many other areas of Great Britain. The equipment is expensive to buy, operate and maintain and their support in prosecution procedures also draws substantial administration costs. However the costs are small compared to the benefits of the society and the economy. Speed cameras are recommended under use to reduce road casualties. Since these cameras save lives of road users, the speed camera is also known as” safety camera”.

Speed camera uses the basic principle of Doppler Effect and RADAR technologies. We can discuss the Doppler Effect in these speed cameras and other working in these cameras. The device, i. e the first generation RADAR is not capable of determining the speed of the detected object. This was limited to measuring the movement of echo on the screen, which gave a rather inaccurate result. As an example consider a car that makes a sound with a fixed frequency. When you are in the car, you won’t notice any variation in the frequency of the engine sound.

However you stand at the side of the road and listen to the car when it drives past under identical condition you will notice that the frequency of the engines sound increases as the car comes nearer and then decreases as the car travels past you. It is a matter of common experience that the pitch of the note appears to change when either source or observers or both are in motion relative to each other. Either the source or the observer or both move

relative to and each other, the apparent pitch produced by the sounding body appears to be higher than actual pitch.

In the same way, when the source moving towards the observer or the observer moving away from this source or both moving away from each other the apparent pitch will appear to be lower than the actual pitch of the sounding body. The apparent change in frequency/pitch due to relative motion between source and observer is known as the Doppler's principle. For example: if a railway engine moving fast with its whistle blowing and is approaching an observer, the pitch appears to become more. The pitch of the note appears to become less just as the engine moves away from the observer on the platform.

Doppler Effect: the principle of this effect is well known in the study of sound. It is known that if the source of sound, emitting a note of frequency ' v' is move with a constant velocity ' V' relative to an observers, it is found that the observer ' p' perceives a sound having the frequency v' which differs from ' v', being greater or smaller according to the source is move towards or away from observers. This phenomenon in sound was first explained by Doppler and hence the name Doppler effect. But Fizeau showed that the same effect on light.

Thus if the source of light is moving with a wavelength observed in the Spectroscope slightly different from the original wavelength. The principle of speed camera that is the Doppler's effect can be described by the formula fM = 2vfEcos(? /c) Where fM if the frequency of the received signal v is the speed of vehicles fE if the frequency of transmitted signal ? is the angle

between the transmitted signal and path along which the vehicle travels c is propagation speed of the signal in the air. Figure 1.

The Doppler Effect From this we can deduce that sending a fixed frequency signal towards the car and then measuring the efficiency of the returning signal the can the deduce the speed of the car. The principal used for Radar in speed camera, although they have little in common with the systems described. It should be mentioned that the sensitivity of the RADAR increases as the angle between the beams and the path of the vehicle decreases. For this reason the aerials of speed cameras positioned parallel to the roads rather than across them!

This is also the reason why only some types of RADAR can work along bends, since the angle between the beams and the vehicle continually changes, creating error the measurement. FROM THEORY TO PRACTICE! Now that we have seen how the Doppler Effect can be used to measure the speed of the vehicles, we will take a look at the commercial applications that are found at the side of the road. The basic of every speed camera is a SHF generator, which can transmit the beams in specific directions. From the previous section we know that the sensitivity of the device is directly of proportional to the frequency of the beams.

The exact frequency depends on the manufacturer, which is generally between 2 GHz and 15 GHz. The power of oscillators is not very high (usually less than 10 mw), but the effect a power output is increased through the use of the directional aerials. The receiver for the reflected signal is often based on a shottky diode a, situated at the focal point of the aerial which functions

as a mixer of transmitted and reflected signal. The output signal of the receiver is amplified, conditioned by an analogue circuit and then passed on to the measurement section, which is nothing more than a frequency counter.

The signal from the frequency counter goes to the microprocessor that calculates the speed and sends it to display. It also checks if the measured speed exceeds the preset value and warns the police officer who are nearby that of offenders has just passed or it activates the camera or flash gun. In short, the basic principle behind a high frequency speed detector is not very complex. Figure 2. Basic Principle of Speed Camera. Now that we know how it all works. We may wonder how reliable the measurements made by these devices are.

We will see the problem from a technical viewpoint to discover that what the limits of SHF speed cameras are. 1. Operating during the rain or mist: In contrast the RADAR works perfectly well during a rain or mist. For example RADAR is used extensively to help the landing of airplanes in bad weather. In general, when it rains it comes down vertically which is right angles to the RADAR beam, bringing about a Doppler effect of zero (cos 90= 0 soFm= 0). Heavy rain that comes down at the angles due to strong gust of wind can’t asset to the signal to noise ratio of the receiver and prevents its correct operation.

In this case the processor will simply rejected the measurements. Since mist doesn’t move with respect to RADAR beams it will be practically invisible to the receiver and the measurements are completely unaffected. 2.

Measurement Range: The distance from which the RADAR can measure the speed of a vehicle depends on two factors: the power of SHF oscillators and the sensitivity of the detector. We already know that oscillators power is generally low and that the use of a directional aerial increases the transmitted power. The biggest problem of the detector is a signal to noise ratio.

In this section the sensitivity can be improved through the use of an aerial. whilst the first Radars could only take measurements up to 20 meters, the newer models with the ultras sensitive detectors are capable of taking a measurements up to several hundred meters, so well before they can be seen from the car! 3. Reaction time: Just as in other equipment that use frequency counters the speed cameras also require a certain time to take a measurement. Furthermore, most devices now take several measurements so rapidly, making it possible to reject any possibly erroneous measurements.

Older models required by about half a second to take a reliable measurement. Current models react with in tenth of a second, so any motorists who ignores speed limit will have little chance of avoid a fine after noticing a speed cameras. Sometimes the RADAR equipment also contains Dsp, which uses special algorithms with the very short time, making extremely fast readings possible. 4. Continuous transmission: In contrast to what you thought after reading the theoretical part, RADAR does not need to have its oscillators functioning continuously.

It only needs to be active long enough to stabilize and take a measurement. Actual RADAR equipment works on the random basis or is activated only when a vehicle comes near by. 5. Discrimination: When several vehicles traveling at different speeds encounter at the RADAR beams the resulting Doppler signal contains a mixture of signals at different frequency. The majority of current devices can’t separate these components and reject the measurement as faulty. There are however newer systems, which can measure the speed of the several car simultaneously.

So now only those cars simultaneously happen to be in’ shadow ‘ of other can escape from the speed cameras. The long and short of it is that speed cameras have become so accurate and reliable that it has become extremely difficult to evade them. ON THE WRONG SIDE OF THE LAW Mankind behave in such a way that when he comes across an obstacle he will try everything to get around it. Speed cameras are no exception to this and numerous boffins have contributed to the development of counter measures. There are two types of ‘ anti-radars’. Jamming devices and detectors.

The jamming devices are simply SHF oscillators, which are used to send ‘ take ‘ signal the to speed camera, causing the measurement to fail and preventing the logical analysis of the frequency. Besides the fact that these devices are relatively in effective, the electronic circuit in the radar can detect such the jamming signals and notify the police. A jamming device is therefore a sure fire way and to get caught. A detector on the other hand consists of the simple SHFreceiver, and by definition this can’t be detected. In USA they are sold in large quantities.

On the Internet they are readily available. These are relatively simple circuit containing a microwave detector an alarm. It is not difficult to design the broadband detector the frequencies between 2 and 10 GHz, which is the range where most of modern device operate. However, if the oscillators of the speed camera is set to a frequency that is out side the range covered by the detector, or it uses an optical laser, then you are bound to get caught. The second problem is that in order to detect something, there first should be something to detect.

Older RADAR equipment transmitted continuously, which made task simple, but newer models only transmit intermittently, either randomly or in short bursts reducing the chance of detecting the devices. Some models are more cunning and only come into action when a car comes within the range. These ‘ Green bullets ‘, as they are known because of the shape and color, have an optical detector on the top that can literally see the vehicle coming. As soon as there is movement in front of the device it springs into action.

This brings us to the third problem: a RADAR detector will sense the beam at that instant. But at the same time the speed camera is already doing its work. From that it follows that in the time taken by the driver to take appropriate action, the RADAR or will already have taken four or five measurements. The detector is made more difficult by the fact that very narrow beams are used, making for a small detection area. Some users of RADAR detectors have noticed that the beam can also be detected when reflected off other cars ahead and have gladly made use of this property.

And now final problem: most RADAR equipment can take measurements of approaching and receding but the sensitivity of most detector is Limited to one direction to be prepared for in the eventually the vehicles should therefore have a detector at both the front and back! COMMUNICATIONS AND PUBLIC AWARENESS The need for public Communications, A key objective was to ensure that people are made fully aware of the speed cameras are for road safety purposes and is not for the raise of revenue.

Although speeding leads to more crashes, deaths and injuries, some commentators argue against speed camera enforcement by claiming that the speeding is not dangerous because speed limit are arbitrary and good drivers has are better able to judge what is safe in given circumstances. Conversely there are a larger number of politicians and road safety, environment and motoring organizations that support efforts to reduce speeding and they are supportive of speed camera. We should make people aware of speeding and benefits of speed cameras.

We should create awareness at the local level, national level and also in government level. We should make partnership with the local and national and government organizations to make awareness about speeding and casualties due to speeding. There are many publicity campaigns, for example called ‘ THINK! ’ which includes messages about the risks and other consequences of speeding. Now we would like to believe that enforcement cameras are there for our on good and make our roads safer.

In general speed camera are perceived to be good idea because they protect innocent road users and pedestrians. Although these cameras reduces

accidents and protects the innocent road users, the way in which the speed cameras are currently used is not to make the driver slow down, obey the speed limit and make the road safe but to catch and penalize the transgressors who may otherwise have slowed down if they would have seen the cameras in advance . i. e. speed camera , as, currently deployed, are not so justifiable .

These cameras are highly visible so no one would travel by them exceeding the speed limit and they would do their job. When used as hidden away, drivers are penalized and hence contribute little to road safety directly by only generating revenue to pay for their installation and maintenance. Despite nearly 4000 driver caught, more than one per minute on average, not one single accident but was reported by the police which just showed that, speed cameras offer a little towards improving road safety but do an awful lot to generate revenue for the local police and local authorities.