**CHAPTER 1**

**INTRODUCTION**

A system that automatically capturing image of a moving vehicle and recording data parameters, such as date, time, speed operator, location, etc. on the image. A capture window that comprises a predetermined range of distances of the system from the moving vehicle can be set by the operator so that the image of the moving vehicle is automatically captured when it enters the capture window. The capture window distance can be entered manually through a keyboard or automatically using the laser speed gun. Automatic focusing is provided using distance information from the laser speed gun. Traffic management and information systems rely on a suite of sensors for estimating traffic parameters. Magnetic loop detectors are often used to count vehicles passing over them. Vision-based video monitoring systems offer a number of advantages. In addition to vehicle counts, a much larger set of traffic parameters such as vehicle classifications, lane changes, etc. can be measured. Besides, cameras are much less disruptive to install than loop detectors. Vehicle classification is important in the computation of the percentages of vehicle classes that use state-aid streets and highways. The current situation is described by outdated data and often, human operators manually count vehicles at a specific street. The use of an automated system can lead to accurate design of pavements (e.g., the decision about thickness) with obvious results in cost and quality. Even in large metropolitan areas, there is a need for data about vehicle classes that use a particular street. A classification system can provide important data for a particular design scenario. Here system uses a single camera mounted on a pole or other tall structure, looking down on the traffic scene. It can be used for detecting and classifying vehicles in multiple lanes and for any direction of traffic flow. The system requires only the camera calibration parameters and direction of traffic for initialization. The seminar starts by describing a camera calibration tool, experimental results are presented, and finally conclusions are drawn.

**1.1: SPEED CAMERAS**

A traffic enforcement camera (also [red light camera](https://en.wikipedia.org/wiki/Red_light_camera), road safety camera, road rule camera, photo radar, photo enforcement, speed camera, [Gatso](https://en.wikipedia.org/wiki/Gatso), safety camera, bus lane camera, flash for cash, Safe-T-Cam, depending on use) is a [camera](https://en.wikipedia.org/wiki/Camera) which may be mounted beside or over a [road](https://en.wikipedia.org/wiki/Road) or installed in an enforcement [vehicle](https://en.wikipedia.org/wiki/Vehicle) to detect [traffic regulation](https://en.wikipedia.org/wiki/Traffic_regulation)violations, including [speeding](https://en.wikipedia.org/wiki/Speed_limit), vehicles going through a [red traffic light](https://en.wikipedia.org/wiki/Red_traffic_light), unauthorized use of a [bus lane](https://en.wikipedia.org/wiki/Bus_lane), or for recording vehicles inside a [congestion charge](https://en.wikipedia.org/wiki/Congestion_pricing) area. The latest [automatic number plate recognition](https://en.wikipedia.org/wiki/Automatic_number_plate_recognition) systems can be used for the detection of average speeds and raise concernsover loss of privacy and the potential for governments to establish [mass surveillance](https://en.wikipedia.org/wiki/Mass_surveillance) of vehicle movements and therefore by association also the movement of the vehicle's owner.

**1.2: TYPES OF SPEED CAMERAS**

There are different types of speed cameras that are design for speed detection of moving vehicle in different ways or method.

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| **1.2.1:** | **GATSO** |

The Dutch company Gatsometer BV supplies speed camera equipment, and has been using radar since 1971. Gatsometer's current radar equipment operates within the 24 Gigahertz-band, which is available worldwide. Gatso speed cameras are most often found in fixed positions by the roadside on poles. They can also be used on a trailer on a tripod. Fixed installation Gatso cameras are rear facing as they use a 'flash' to photograph the vehicle. They do not flash the front of a vehicle because this would dangerously distract the driver. Sometimes Gatso cameras are reversible and can be turned to face different directions. The photographs are taken using standard 35mm films with a capacity of around 400 pictures. These films must therefore be changed regularly.

### Related image

### 1.2.2: ****TRUVELO****

The manufacturer Truvelo is best known for the introduction of front facing speed cameras in the UK. The Truvelo camera is a forward facing camera taking pictures using an infrared flash gun (the driver will not be able to see the flash so as not to distract or cause temporary blinding). The camera film is sensitive to infrared: the reflected light provides the film with the correct exposure resulting in a crystal clear picture of the driver committing the offence (incriminating evidence).   
The piezo road strips (inductive loops) are a known distance apart, and the time between compressions is measured to give the resulting speed of the vehicle. The system takes a single photograph along with four readings on a two axle vehicle and uses the average time for compressions to calculate the resulting speed

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**1.2.3: SPECS**

SPECS is a digital camera system which calculates an average speed by reading number plates a set distance apart and measuring the time taken. A SPECS system must consist of two or more cameras working together. As a vehicle drives past the first, the infrared sensors either side of the camera take a reading of the number plate. Now the vehicle drives past the second camera and the information is stored again, and so on to the end of the SPECS zone. From the information received it can calculate exactly how long it has taken that vehicle to travel from point A to B. By calculating distance travelled over time taken it can work out your average speed within the SPECS zone. The information can then be relayed by transmitting to a central office via fibre optic cables or recorded on discs stored in cabinets at the roadside. This can be collected and changed, by police or speed check staff. Linked to DVLA or PNC computers, these can provide driver details which can be used to track down offenders.

**1.2.4: LASER**

The majority of safety camera vans are using laser-based systems to measure a vehicle's speed. These will normally have some sort of video equipment attached to record the evidence.   
Mobile laser systems are often found in vans, which can target vehicles from short or long range. The laser is aimed at the number plate and the returned signal bounces back to the gun to determine the speed. Evidence of which number plate was targeted is recorded on the video, or may be noted by the operator. Laser is a very accurate system, with a speed acquisition time as little as 0.3 seconds. T his is the reason laser guns are being used rather than the old-fashioned radar guns, which found it hard to determine which car was the target. There are various types of laser equipment in use, but all currently use the same 904nM light beam.



**1.2.5: MINIGATSO**

These are a type of portable camera, made by Gatsometer BV. They are normally used with a van in situ but can be separate. They use radar to measure your speed and photograph you as you pass, like a standard fixed Gatso camera. Mobile camera sites can be set up as and when required, so they have the flexibility to be used in many locations on the same day. They are a deterrent to speeders, although the van should be parked in a safe position so as not to cause any obstruction to other road users.



**1.2.6: SPEEDMASTER/AUTOVISION (DS2, DS3, TSS)**

TSS has been supplying traffic law enforcement & video surveillance technology to customers worldwide for 30 years. This system is quite discreet compared to the traditional roadside camera poles. Cameras plug in to a roadside sensor on a random basis to allow offenders to be recorded. It operates by measuring speed by time and distance travelled. There are pressure sensors on or under the road surface, carefully spaced apart. Two separate readings of the vehicle's speed are taken, to ensure accuracy. Like VASCAR video, the offending vehicles are recorded. In automatic systems this evidence can be processed later, in manned operations the user radios ahead to colleagues who can pull the driver over.

**1.3: THE POSITIVE AND NEGATIVE EFFECT OF SPEED CAMERAS**

Speed cameras can detect the speed of vehicles through the use of radar technology or detectors that are embedded in the surface of the roadway. If a vehicle’s speed is detected to be higher than the posted legal limit, a photo is snapped of the car, stored digitally, and later printed along with a speeding ticket. The ticket is then sent to the address to which the photographed vehicle is registered. The debate rages on about whether or not speed cameras actually help to increase driver safety and general safety on the roadways. While organizations like the NMA (National Motorist’s Association) oppose these cameras, some evidence suggests that drivers do tend to watch their speed in areas that are known to have speed cameras. The following are some of the pros and cons of speed cameras as they relate to driver safety.

**1.3.1: POSITIVE EFFECTS (PROS) OF SPEED CAMERAS**

While many of the positive effects of speed cameras are anecdotal, it can’t be denied that the awareness that there might be cameras on any given roadway tracking speed tends to affect the psychology of many drivers. Motorists who would otherwise not be cautious are thinking twice about speeding, especially in urban areas and school zones.

**Situational compliance.** Once a driver is aware that a speed camera is installed in a certain area, they tend to behave themselves and drive the speed limit in said area.

**Random uncertainty.**If a driver encounters enough speed cameras, they will be more likely to wonder (or assume) if there are such cameras anywhere they drive, especially in urban areas and school zones.

**1.32**: **NEGATIVES (CONS) RELATED TO SPEED CAMERAS**

The National Motorist’s Association (NMA) and other organizations oppose speed cameras; here are some of the reasons they cite for being against them.

**Slowed speeds.**An awareness of the presence of a ticket camera can cause some drivers to drive below the posted speed limit, creating a road safety hazard.

**False readings.**Radar-triggered cameras are imperfect and can result in tickets being generated for false readings.

**No evidence of improved safety.**NMA believes the companies that sell the ticket camera equipment and services are biased and offer no independent verification that these systems actually do reduce accidents, improve highway safety, or help to regulate roadway traffic flow.

**No accuser.** It is a constitutional right for accused persons to confront their accuser, but in the case of these cameras, there is no human being to confront.

**CHAPTER 2**

**LITERATURE REVIEW**

**2.0: BRIEF HISTROY ON SPEED CAMERA**

The concept of the speed camera can be dated back to at least 1905; Popular Mechanics reports on a patent for a "Time Recording Camera for Trapping Motorists" that enabled the operator to take time-stamped images of a vehicle moving across the start and endpoints of a measured section of road. The timestamps enabled the speed to be calculated, and the photo enabled identification of the driver.

The Dutch company *Gatsometer BV*, which was founded in 1958 by [rally](https://en.wikipedia.org/wiki/Rallying) driver [Maurice Gatsonides](https://en.wikipedia.org/wiki/Maurice_Gatsonides), produced the '[Gatsometer](https://en.wikipedia.org/wiki/Gatso)'. Gatsonides wished to better monitor his average speed on a race track and invented the device in order to improve his lap times. The company later started supplying these devices as police speed enforcement tools. The first systems introduced in the late 1960s used [film cameras](https://en.wikipedia.org/wiki/Film_camera) to take their pictures. Gatsometer introduced the first red light camera in 1965, the first [radar](https://en.wikipedia.org/wiki/Radar) for use with road [traffic](https://en.wikipedia.org/wiki/Traffic) in 1971 and the first mobile speed traffic camera in 1982;

From the late 1990s, [digital cameras](https://en.wikipedia.org/wiki/Digital_camera) began to be introduced. Digital cameras can be fitted with a network connection to transfer images to a central processing location automatically, so they have advantages over film cameras in speed of issuing [fines](https://en.wikipedia.org/wiki/Fine_%28penalty%29), maintenance and operational monitoring. However, film-based systems may provide superior image quality in the variety of lighting conditions encountered on [roads](https://en.wikipedia.org/wiki/Road), and are required by courts in some jurisdictions. New film-based systems are still being sold, but digital pictures are providing greater versatility and lower maintenance and are now more popular with law enforcement agencies.

**2.1: MOBILE CAMERAS**

The mobile cameras are the ones to be found on police vehicles. Also referred to as radars, they come in a variety of shapes and sizes, being vehicle – mounted, handheld, tripod mounted and concealed (meaning hidden where you least expect). This type of camera comes with its built in detection equipment, allowing the carrier to accurately record the speed of incoming motorists regardless of the carrier moving with or against the flow of traffics. The cameras is based on laser technology (Light Amplification by Stimulated Emission of Radiation), emitting a light beam towards the incoming vehicle. It takes the beam 0.3 to 0.7 seconds to acquire and register a target at an operational rage of 800 meters.

What happens after the target is locked is called the Doppler effect and can be explained like described below. The rader sends out the aforementioned beam at specitic frequencies and at an angle across the roadway. When a car enters its field, the radar is reflected and the beam changes frequency because of the relative motion betwiin the rader and the vehicle. The degree in which the frequency increases or decreases depents on the speed at which the passing vehicle is travelling. Mobile cameras are also capable of detecting the direction in which the monitored vehicle is travelling in. frequency is the main tool here as well: if it increases, the vehicle is incoming, while if it decreases, the vehicle is moving away from the carrier.

According to Amanda D. H. (2005) the use of automated speed enforcement technologies is now wide speed throughout many parts of the world and research has consistently demonstrated the positive road safety benefits achieved through the use of these technologies. However, there is wide variation in the nature extent of use and perceived acceptability of automated enforcement technology, particularly as the primary form of speed enforcement.

Despite these differences controversies associated with the use of speed enforcement technology have arisen in each jurisdiction and some common elements across jurisdictions are evident

**CHAPTER 3**

**METHODOLOGY**

**3.0: INTRODUCING THE DOPPLER EFFECT**

The device that is 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 the 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 observers 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 observers or the observers 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 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 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 observers 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(α/c)***

Where:

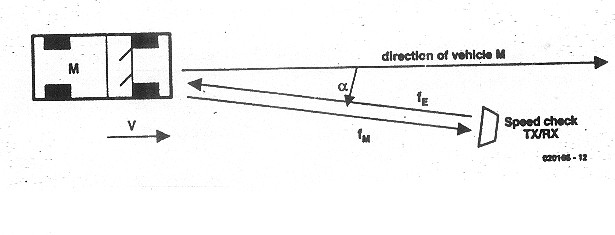
FM if the frequency of the received signal

v is the speed of vehicles

fE if the frequency of transmitted signal

α 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.

## 3.2: HOW WELL DOES IT WORKS

Now that we know how it all works. They 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 they 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 they oscillators, power are 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 the 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 nearby.

**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 that Dsp, 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.

### 3.3: ON THE WRONG SIDE OF THE LAW

Mankind, and especially homo automobiles, behave in such a way that when he comes across an obstacle he will try everything to get round of 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 is 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 SHF receiver, 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 oscillator of the speed camera is set to a frequency that is outside the range covered by the detector, or it uses an optical laser, then you are bound to get caught. In 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!

##### **CHAPTER 4**

##### **CONCLUSION**

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 have seen as the cameras in advance .i.e. speed camera , as, currently deployed, are not so justifiable .

These cameras were highly visible then no one would travel by them exceeding the speed limit and they would do their job. Used as they hidden away, they are penalized and contribute little to road safety directly 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, speedier offer a little towards improving road safety but do an awful lot to generate revenue for the local police and local authorities. Although road safety strategists are introduced to reduce the number of people killed and serious injured that is to support new casualty reduction largest.

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