Traffic Advisor: interaction between vehicle movements and traffic light control

in the citeeecar system

It is assumed that in Germany three times more people die prematurely because of particulate matter from exhaust gases than in traffic accidents, namely around 10,000! A quarter of the pollutants from the average car journey are inhaled at traffic lights. The consequences are respiratory and cardiovascular diseases, possibly also lung cancer and diabetes - and our life expectancy is reduced by 1-3% depending on the study. The car´s acceleration process can throw ten times more dirt out of the exhaust than the idle mode is already emitting.

Now, does the electric car solve the problem? No! Most of the fine dust (over 60%) is caused by abrasion of brakes and tires, and since e-cars are often even heavier than combustion engines, the road is more heavily loaded, the tires rub off more (approx. one pound of rubber per year and car), only the recuperation brake can reduce brake abrasion - however, it does not work exactly here, because at low speeds you reach the Low Speed Cutoff Point (LSCP), so back to mechanical brakes, and this abrasion accounts for approx. 20% of fine traffic dust.

So how can fine dust be reduced?

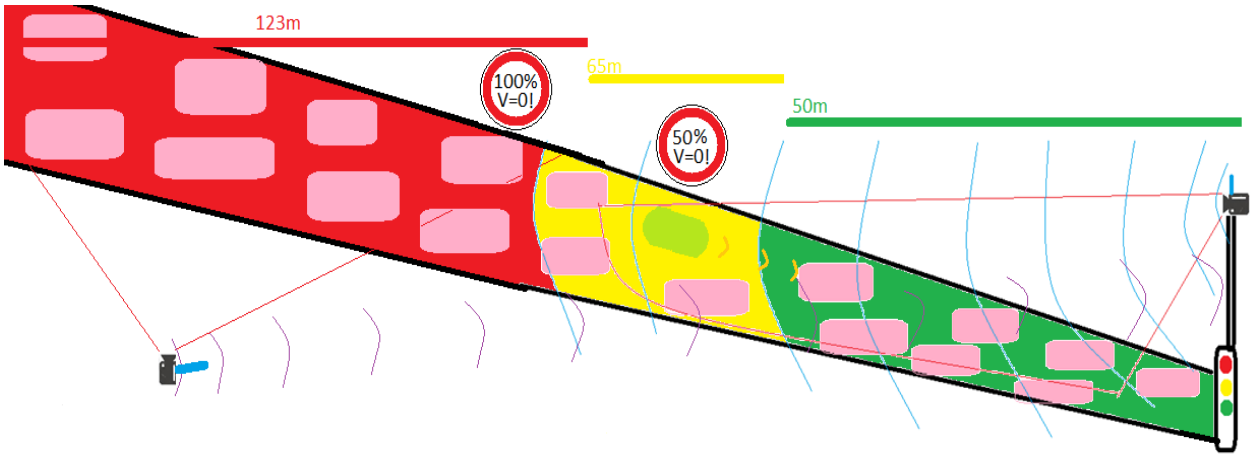
If we still want to drive so much, individually, even in SUVs, we have to make the traffic as speed-constant as possible! Stop and go is the largest source of particulate matter in traffic, i.e. in front of the traffic lights. Who does not step on the gas 100m before the traffic light, hoping to get over it - after all, the red phase would cost a lot of exhaust gases and fuel - and our time, of course ... and then we will not make it and have to brake hard. Annoyed, you then boost your car aggressively on the next green to make up for the lost time. We are so human…

So that definitely doesn’t sound like fine dust reduction. If only you knew when the traffic light would switch. Actually, it's more of a question whether you can still get over it, including the flow of traffic in front of the traffic lights. Someone would have to analyze the red light phase and calculate the distance at which it can still be passed, and the car would have to know the distance to the traffic lights. But let s avoid further distraction by observing yet another display - and it would also be nice if every road user received this traffic light information, because pedaling hard to brake hard doesn’t amuse the cyclist - and also the bus driver could work much more relaxed. The maintenance costs of all participants are reduced, the tires last longer, and the municipalities have lower costs. Such info system could significantly reduce the fine dust. Is there such a traffic light phase information system with data transmission to individual road users?

Yes, the technical thing tank Geniusthingks has developed just such a system.

The patent "thermoforming large foils in a hot liquid medium for accelerated mass production" describes the industrial production of, for example, 1 million citeeecars per year per production facility. This three-

seater electric car is intended to make a contribution at the individual transportation solution level and logistically combines the individual goal with systematic infrastructure by receiving traffic light data, evaluating it and adapting it to the traffic flow analyzed by the traffic light system. The data exchange is explained in the following picture:



So far, one assumes an enormous data flow through sending cars, which is why 5G networks are necessary. This scenario may be feasible in the future, but the transition period must cope with autonomous sending cars, non-sending cars hybrids as well as human-controlled vehicles (sending and not sending). A perfectly chaotic mix that will occupy us for the span of at least two generations of people, because each implementation takes longer than you think ...

A complete integration of all participants in orderly control systems - as we know it perfectly in controlled airspace - currently seems unlikely. However, if not every participant sends his position, speed and direction, any data reception will make sense, they would only pretend false security. Many-to-many communication required secure and reliable 5G transmission from all participants, as many-to-one would do as well. So there remains only the well know reliable one, because of secured city infrastructure -and inexpensive to implement: the one-to-many control.

The citeeecar houses one of these inexpensive receivers (or your mobile) and indicates to the driver which speed adjustment in the flow of traffic makes sense on the respective street. The purely passive indication system in the citeeecar can be automated step by step, so that the vehicle ultimately adapts to the traffic, but also specifies the speed (e.g. slower than the vehicle in front, because it knows that it will no longer be possible to cross the intersection on green) and therefore acceleration temptations and tire wear on uninstalled vehicles are prevented. Thus, a “simple” traffic flow-based radio signaling system that uses traffic signals provides for less fine dust from tire and brake wear and lower energy consumption - and traffic safety increases enormously. A Bluetooth system is possible (eg ver5 = 240m range), so that without GPS / 5G, the RSSI signal from the tiny device in the car could be evaluated and the data record ("green-distance-limit" / seconds) displayed. Composite electronics could vibrate the joystick in the

recommended direction in order to drive according to traffic lights - or, for example, a Smartwatch with BLE vibrates on the driver's arm.

The cheapest system has already been successfully tested: Weatherproof camera with microphone via Ethernet to Jetson Nano, traffic light phase information via Arduino nano, the LDR boards (light sensitivity sensors) attached to the Jetson board and an LDR to each of the three traffic light colors, data transmission via Bluetooth 5 dongle and directed Antenna to a mobile (any new generation ios/Android), which now shows the green line in meters and the time until red, for example, and can also use vibrators to draw attention to new information. This means that every road user can use the traffic light data, from pedestrians, cyclists, motorbikers and motorists to buses.

Further services are offered to the cities: statistics of traffic movements, peak, per hour, day, week, month, year, vacation time, public holidays, etc., also by type (motorbike / bike / car / truck); real time statistics to admin via special line for the purpose of central traffic management; sidewalk monitoring, eg fallen person = alarm image to admin; stationary traffic on a lane during lane change maneuvers behind a standing car = probability of accident = alerting admin; attaching a microphone to each traffic light = sound triangulation for the purpose of Db measurement of a sound source beyond the permissible limit, recording and image to admin with data record; monitoring of side back streets approved for e-cars = picture when combustion engine detected = sound monitoring and notification / image to admin.

The functions are shown in the following image:

Image explanation:

The AI camera system analyzes the flow of traffic and calculates the movements of the participants. From this data is calculated how far the last participant may be distant at maximum to the traffic light in order to pass on green during the current green phase. This distance in meters, together with the seconds-to-red information, is sent by the Bluetooth transmitter of the approx. 20x20x10cm traffic light box to the mobile or wristband of the participant at 1 second-intervals -up to 300m, by unidirectional and directed transmission.

The mobile/wristband determines its distance relative to the transmitter and can now use color and vibrator to indicate whether the participant can make it at the current green. The seconds-to-green information also helps to decide whether it makes sense, depending on the vehicle, to switch off the

engine. Depending on the distance to the traffic light in the queue, the vibrator would then signal about 5 seconds before the possibility of moving that the engine should be started. So the driver could have less stressfully a conversation until restarting the engine. One look at the bracelet and you already know when you have to concentrate on the traffic again.

The Traffic Advisor offers many more functions:

In multi-lane roads, the system recognizes the standstill on one lane, coupled with a lane change on the more fluent side(s), and immediately informs the administrator via his Bluetooth dongle or another transmission channel, depending on the configuration. Help can be called immediately or redirects can be activated - if the system does not act automatically. In addition, the incident was filmed before it happened, making it easier to process. But knowing about the capacities of the system alone will make road users act more cautiously.

The traffic advisor also recognizes sound signatures, e.g. from the police, fire brigade and ambulance, and paired with detected blue light, the system can immediately alert the admin, so that the traffic light system switches phases as quickly as possible and lets the helpers pass on green instead of having to squeeze through a car alley.

A person walking across the street is recognized and an alarm is given, just as with a falling pedestrian lying on the pavement, or with strikingly fast running people: every action is configurable.

For example, a combustion engine can be detected if it enters a street that is only approved for electric vehicles, or if a vehicle crosses a solid line, the use of all options must be determined by each municipality individually for each traffic light, time of day and day of week etc.

Tuned engines, drilled exhausts, spinning tires, senseless accelerator pedal games: noise is - besides every unnecessary particulate matter action - a pain! A microphone is integrated in the Traffic Advisor system, which measures the decibels, identifies the source via triangulation of the camera network and films the cause. The administration has the possibility to change the behavior of the road user or to check the vehicle, the license plate was filmed.

Statistics are of course important for smooth traffic, as is a real-time assessment of the traffic situation. The Traffic Advisor fulfills both tasks: instead of only measuring the crossing of traffic lights with an induction loop in front of the traffic light, it can look hundreds of meters ahead and qualify the flow.

Depending on the perpendicular traffic, an algorithm can be selected that generates the least fine dust overall. The statistics help to record the average speeds per phase, hour, day, period, etc. and to transmit data to the admin or the central computer for central flow optimization.

As emission reduction is the main task, a particle matter device is included that sends its peak and i.e. hourly PM 0.3-10µm/L data via the chosen admin channel, a CO2 sensor and data would also be possible.

It should be further noted that the traffic system can send data to the mentioned wristband as well as to and bluethooth-mobile device every driver carries anyway. Also it is possible to send further data, like

accidents, jams, icing, parking fees in the street, PM-data, street speed limits or even commercial info paying for the whole system in the long run if the community chooses to offer such services –controlled by the admin system, distributed by each traffic system individually.

The sending directions will be twofold: against traffic for greenphase infos, with traffic (behind traffic light) for further infos like parking fees, jams, icing, etc. The receiving devices differentiate the infos according to growing or weakening RSSI-signal strength.

Further information regarding the integration and signal conversion is available on the website citeeecar.com.