

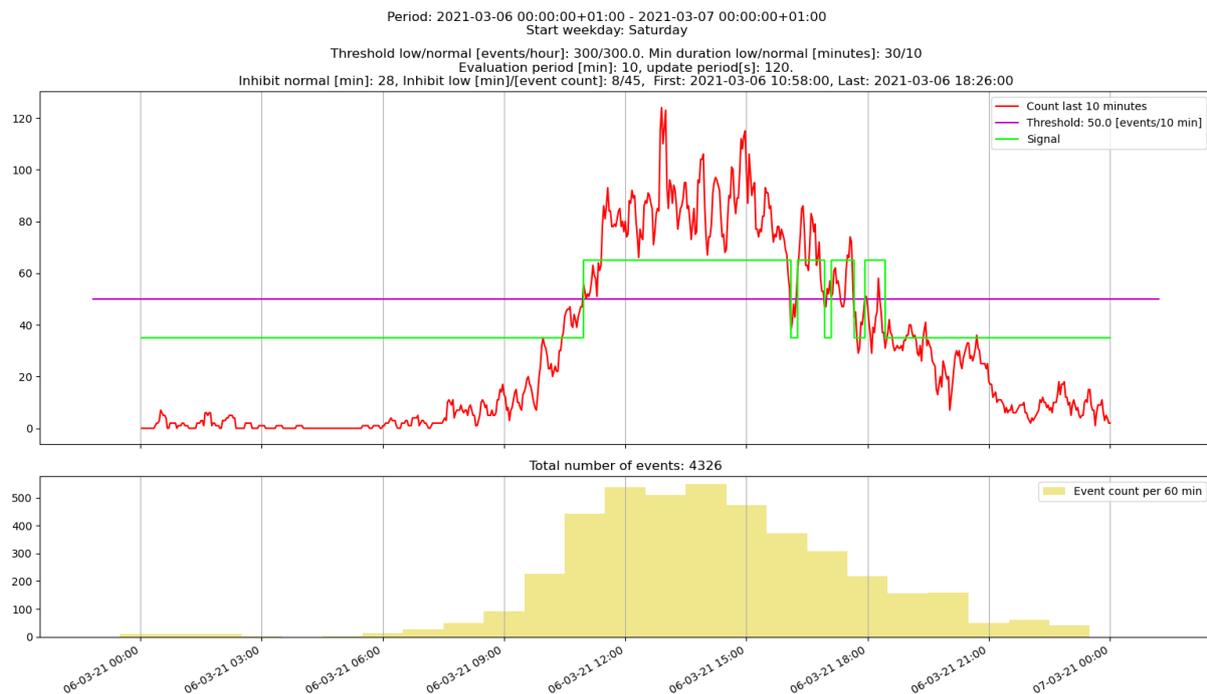
## Change log

Revision	Change	Date	Sign
1	First issue	2021-05-11	KB

## 1. Document

Short description of suggestion of parameters to recommend transitions between normal speed and low speed, depending on flow of pedestrians.

## 2. Description of parameters



- Upper plot
  - Red: pedestrian count evaluated every 120 s, based on the last 10 minutes
  - Magenta: threshold for transition between normal and low speed
  - Green: recommendation (low level => normal speed, high level => low speed)
- Lower plot
  - Number of pedestrians passing a certain detection line per hour.

### 2.1 Parameters

This suggestion implements the following parameters

- Evaluation interval [seconds]
  - Time between count evaluation, 120 s in the example above  
Every 120 s the algorithm tests the pedestrian count, during the evaluation period, against the threshold
- Evaluation period [minutes]
  - Pedestrian count is based on this time period, 10 minutes in the example above
- Min duration low [minutes]

- Minimum time the recommended speed is low  
30 minutes in the example above
- Min duration normal [minutes]
  - Minimum time the recommended speed is normal  
10 minutes in the example above
- Threshold low [counter/hour]
  - Pedestrian count threshold to pass to activate recommended low speed  
300 pedestrian/hour in the example above
- Threshold normal [counter/hour]
  - Pedestrian count threshold to pass to activate recommended normal speed  
300 pedestrian/hour in the example above

## 2.2 Evaluation

In order to evaluate the current parameter setting, the following measures are suggested. Both should be minimized for good performance, but should be balance against number of transitions between normal and low recommended speed.

- Inhibit normal [minutes]
  - Time the recommendation has been low speed, even if the threshold value for normal speed is passed. This is due to min duration constraint.
  - This is time trucks are recommended low speed, even if the current flow would allow normal speed
- Inhibit low [minutes/pedestrian count]
  - Time the recommendation has been normal speed, even if the threshold value for low speed is passed. This is due to min duration constraint.
  - This is time and count pedestrians are exposed to normal speed, even if the current flow would recommend low speed

## 3. Parameter selection

When implementing the algorithm, the design might handle all of the above stated parameters. This allows for easy adjustments of schemes for parameter selection.

**One** suggestion is to set the following parameters to constant values.

- Evaluation interval, 120 seconds
- Evaluation period, 10 minutes
- Min duration low, 30 minutes
- Min duration normal, 10 minutes

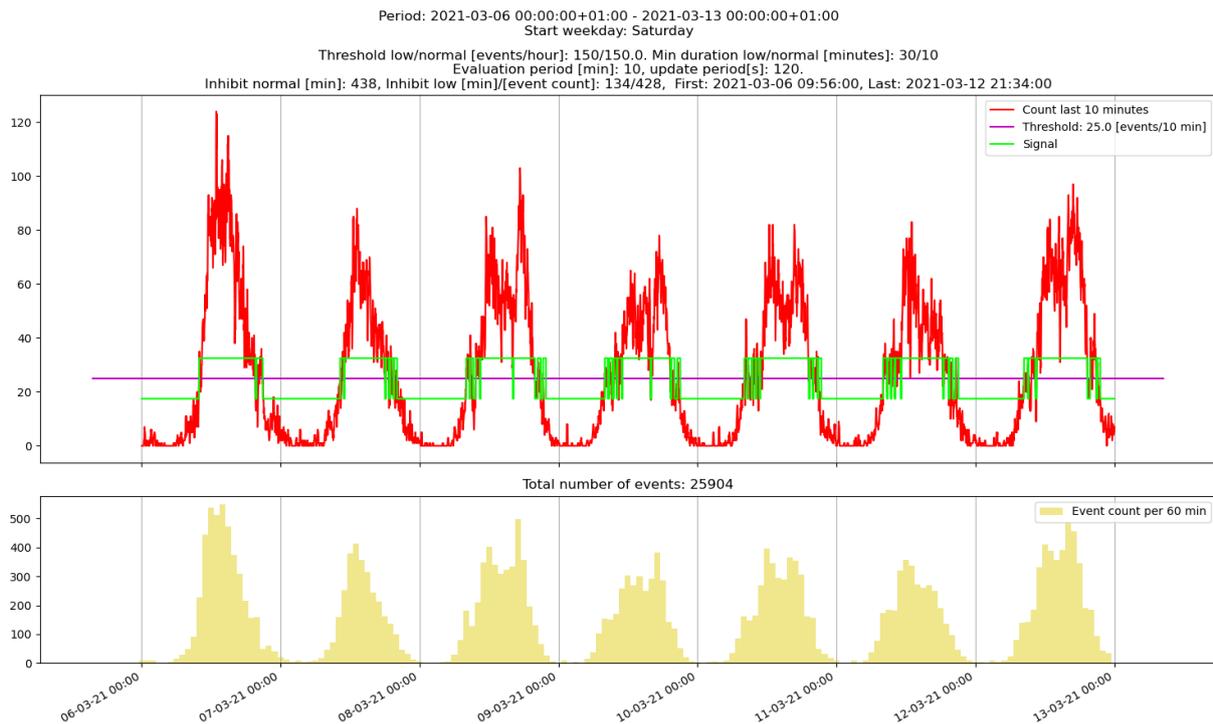
The following will hence be free to adjust

- Threshold low
- Threshold normal

### 3.1 Variation in pedestrian counts

Variation in pedestrian counts might vary depending of weather, time of week, time of year, local events etc., etc.

It is important to be able re-evaluate the parameter settings depending on measurement data.



## 4. Strategy for setting parameters

### 4.1 Factors

- Safety of vulnerable road users (experienced and real)
- Environment (pollution (CO2 footprint and exposure), noise)
- Trust of the system (driver experience, # transitions)
- Structure of in-data
  - Absolute counts
  - Time constants (cause of variation, e.g., time of day, arrival of bus/train)
- Placement of sensors

### 4.2 Strategy

- Set system to be responsive. Short time constants and short min durations
- Try to limit “too many” transitions by one or few parameters

#### 4.2.1 Version 1

The following parameters have a faster response and fewer transitions.

Min duration low/normal = 0/0 minutes

Evaluation period = 10 minutes

Update period = 60 seconds

Thresholds upper/lower = 240/144 events/hour (60%)

However, the min duration times are set to 0 s.

- Original

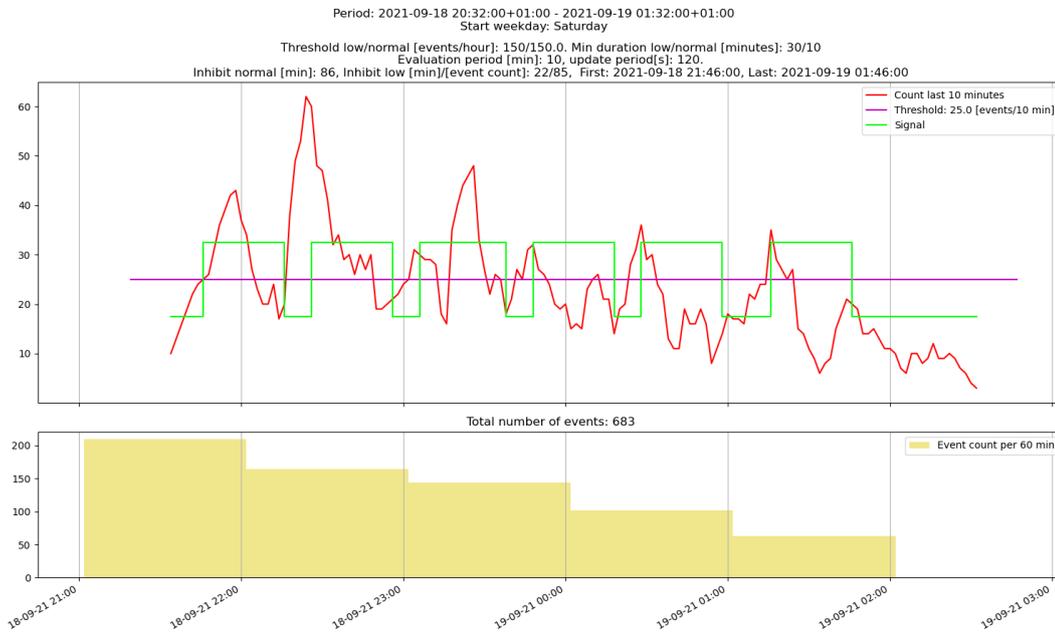
Min duration low/normal = 30/10 minutes

Evaluation period = 10 minutes

Update period = 120 seconds

Thresholds upper/lower = 150/150 events/hour

Comment: Inadequate setting. Min duration times mask out peaks.



- Fast response

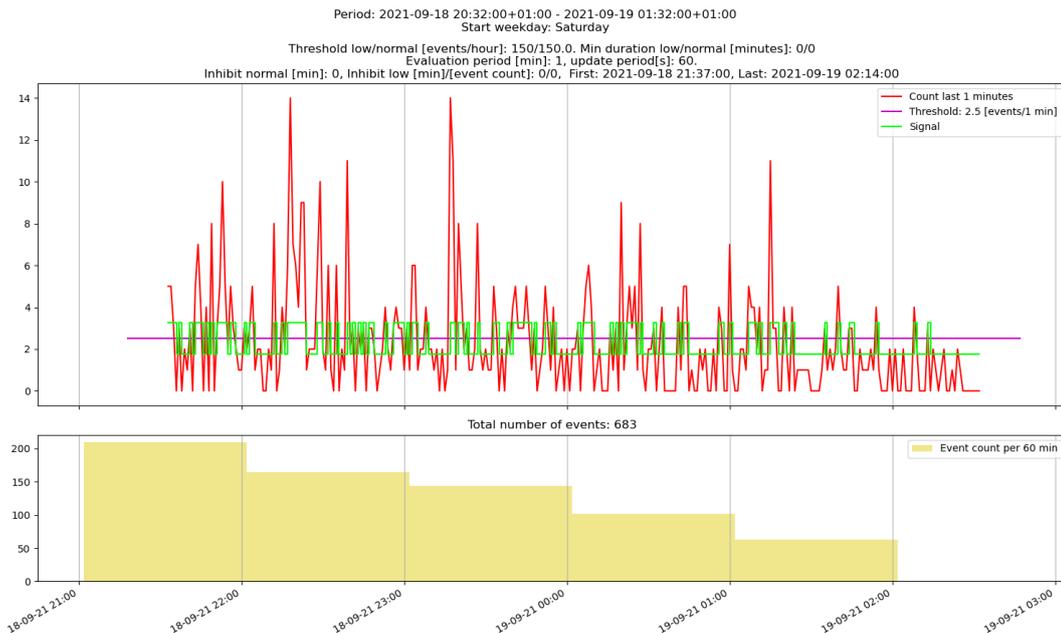
Min duration low/normal = 0/0 minutes

Evaluation period = 1 minutes

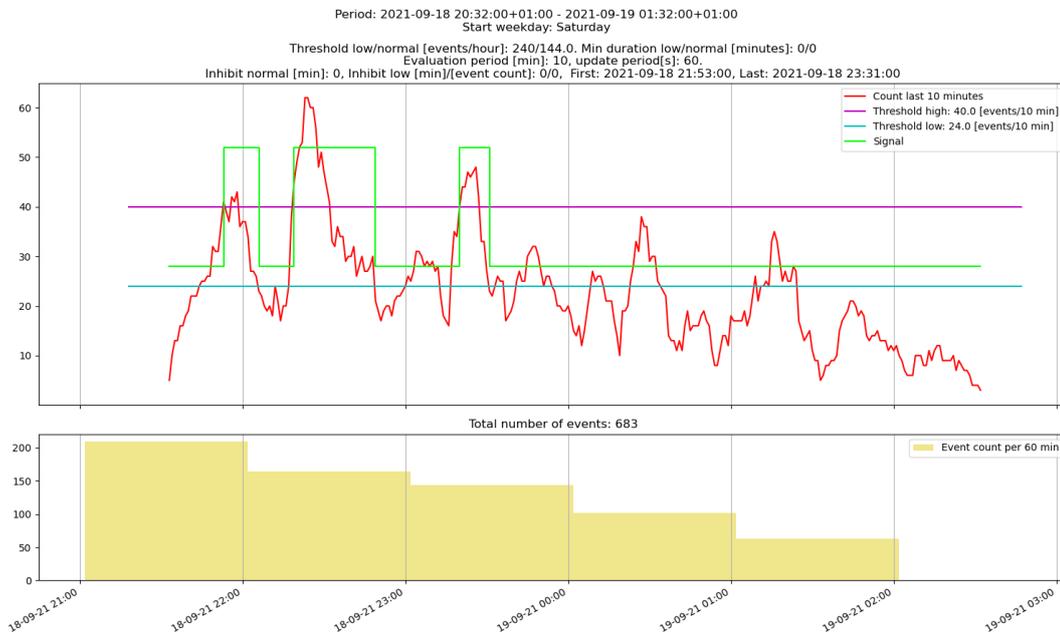
Update period = 60 seconds

Thresholds upper/lower = 150/150 events/hour

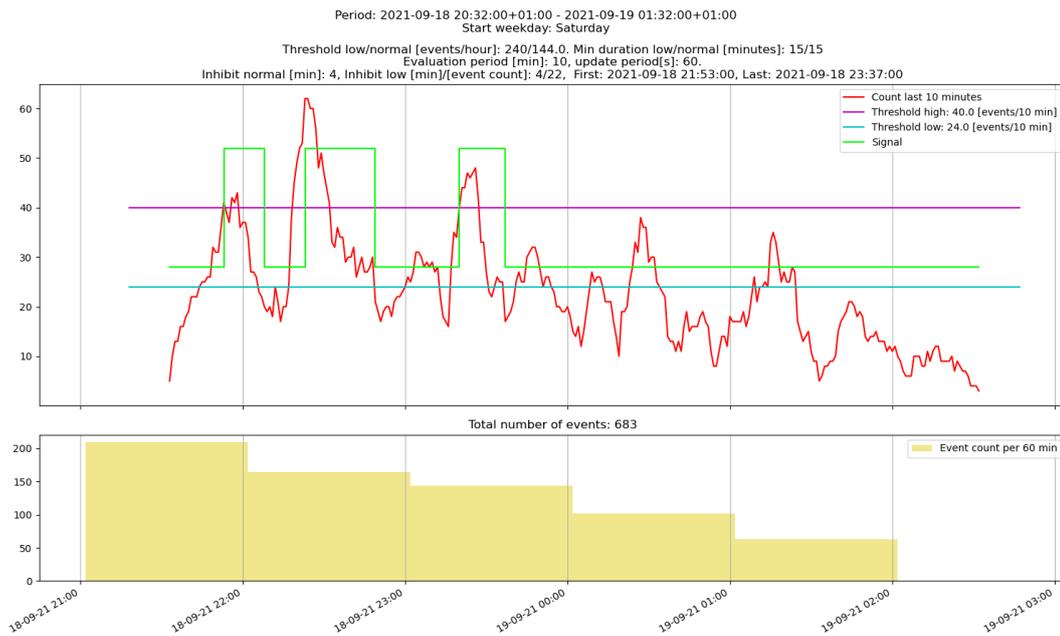
Comment: Inadequate setting. Too many transitions. Peaks are not that high!



- Eliminate some transitions  
 Min duration low/normal = 0/0 minutes  
 Evaluation period = 10 minutes  
 Update period = 60 seconds  
 Thresholds upper/lower = 240/144 events/hour (60%)  
 Comment: use hysteresis and longer evaluation time to find reasonable behaviour

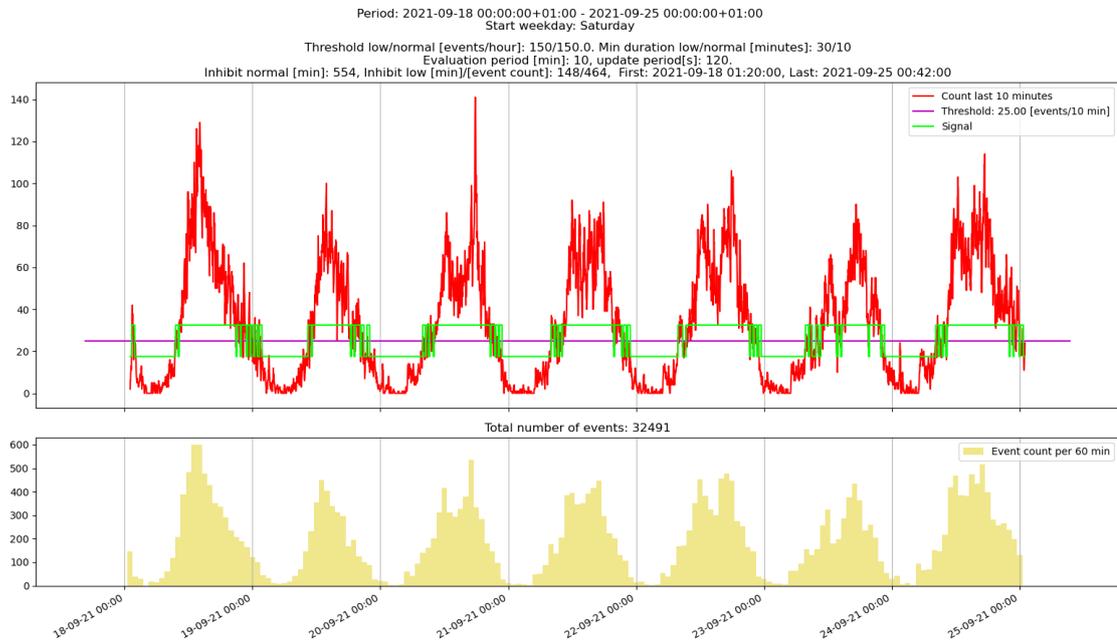


- Introduce min-times for speed recommendation (not recommended)  
 Min duration low/normal = 15/15 minutes  
 Evaluation period = 10 minutes  
 Update period = 60 seconds  
 Thresholds upper/lower = 240/144 events/hour (60%)  
 Comment: min duration times delays transition



#### 4.2.1.1 Weekly

- Original
  - Min duration low/normal = 30/10 minutes
  - Evaluation period = 10 minutes
  - Update period = 120 seconds
  - Thresholds upper/lower = 150/150 events/hour



- Eliminate some transitions
  - Min duration low/normal = 0/0 minutes
  - Evaluation period = 10 minutes
  - Update period = 60 seconds
  - Thresholds upper/lower = 240/144 events/hour (60%)

