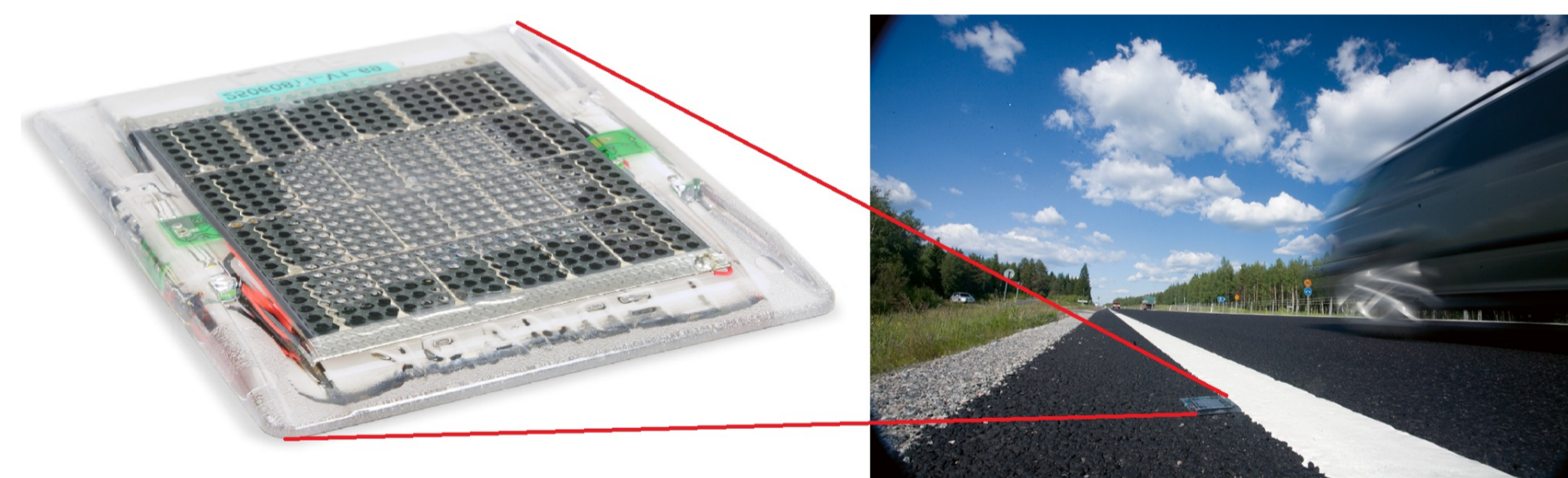


## Contribution

We present a novel approach for computing the heading direction of a vehicle by processing measurements from a 2-axis magnetometer. This two-fold classification problem is accomplished by extracting one strong feature from the data.

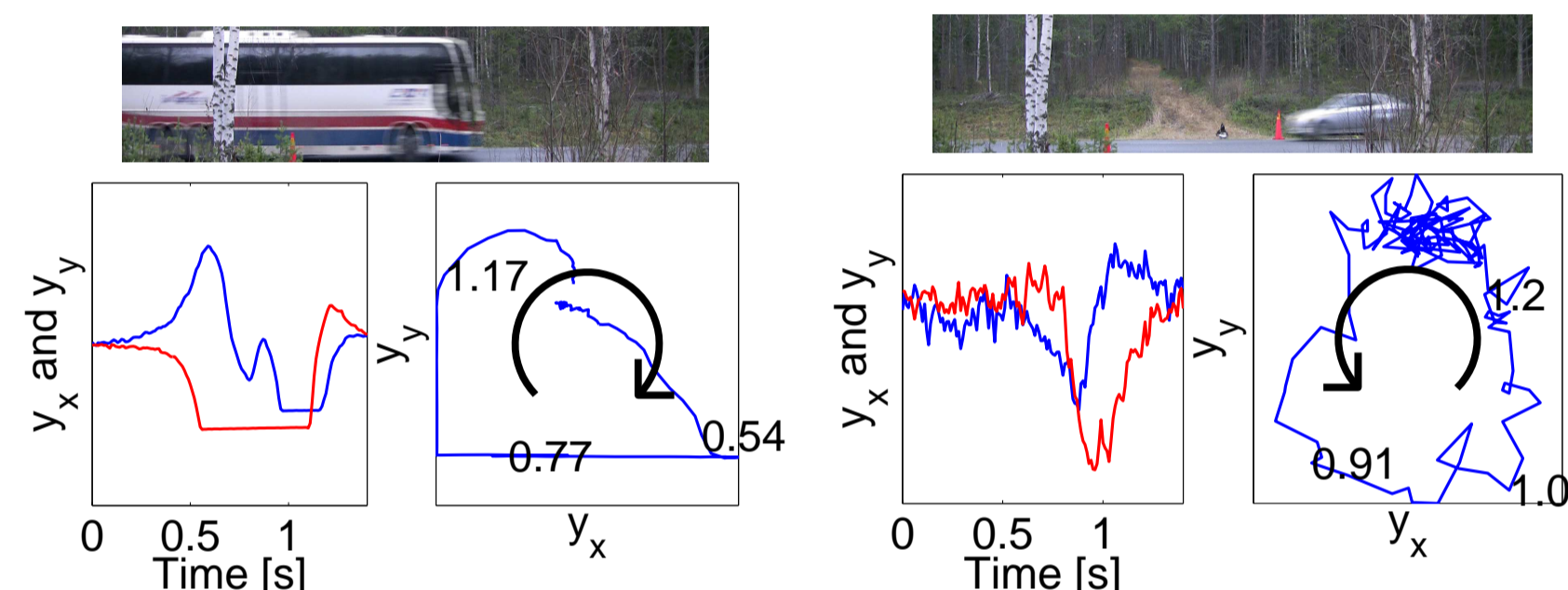
## Background



Existing methods for traffic monitoring are challenged by emerging solutions based on small-size, low-cost sensors such as microphones or magnetometers. These sensors are often incorporated in sensor nodes for wireless sensor networks (WSN), which brings limitations in terms of the energy budget or computational power. Thus, low-complexity data processing algorithms are much needed.

## The Data

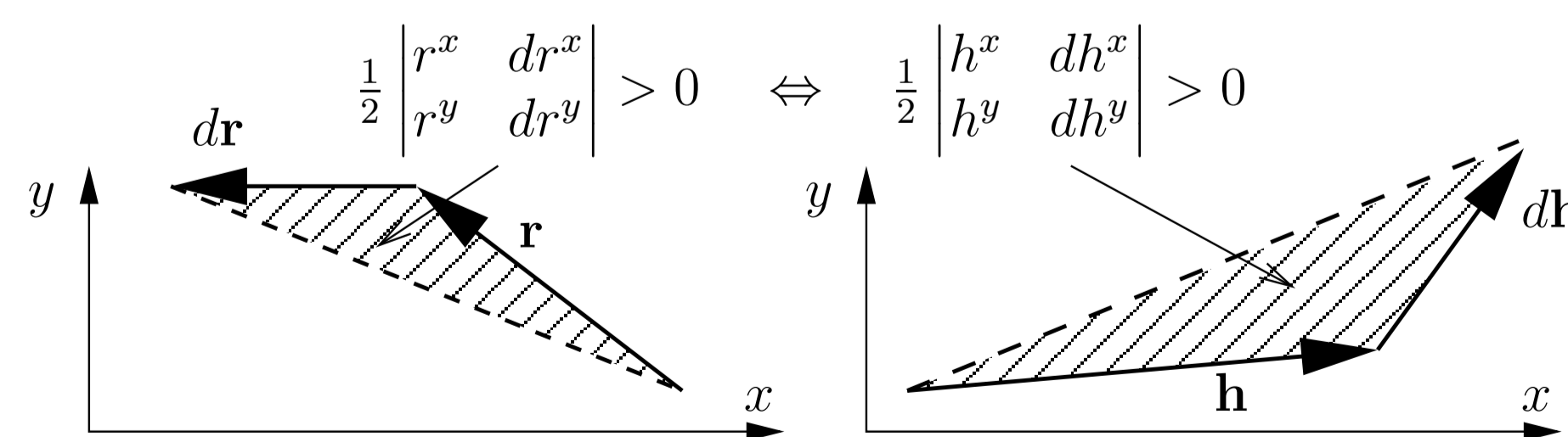
The trajectory of the  $x$ - and  $y$ -components of the magnetometer indicates that it turns clockwise if the vehicle passes the sensor in a clockwise sense and counter-clockwise otherwise.



The vehicle is coming from the left heading right. The vehicle is coming from the right heading left.

## The Method

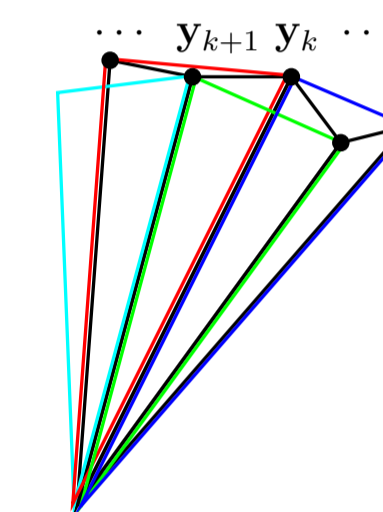
Using the magnetic dipole model, it can be shown that the magnetic field vector  $\mathbf{h}$  exhibits the same direction of rotation as the position vector  $\mathbf{r}$ .



The direction of rotation can be determined by

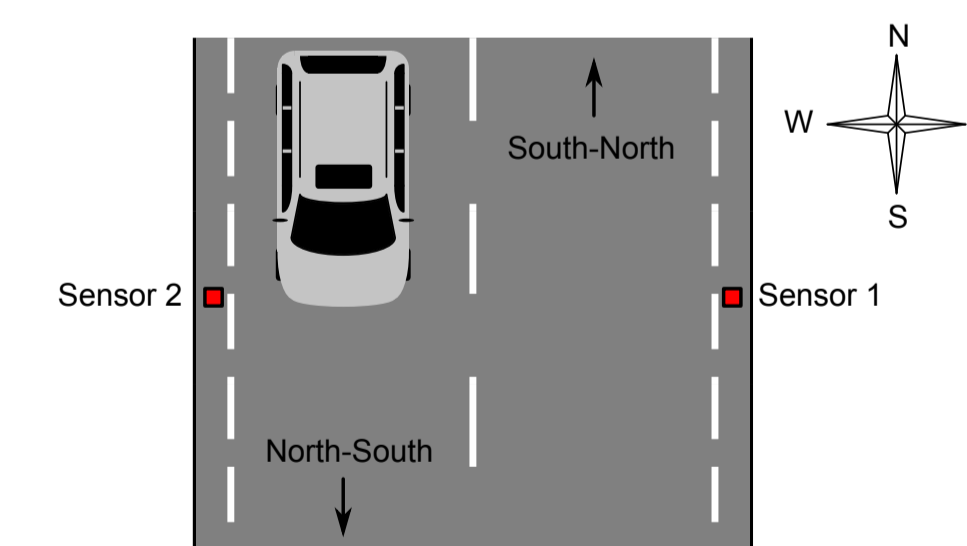
checking the sign of the area enclosed by the trajectory of  $\mathbf{h}$ . The area is estimated using the noisy measurements  $\mathbf{y} = \mathbf{h} + \mathbf{e}$ . Averaging over a larger set of sub-areas is performed in order to reduce the effects of the noise.

$$\hat{f}_p = (\mathbf{y}_{1:(N-p)}^x)^T \mathbf{y}_{(1+p):N}^y - (\mathbf{y}_{1:(N-p)}^y)^T \mathbf{y}_{(1+p):N}^x$$



## Experimental Results

Excellent performance is achieved on a set of real measurement data. Only one wrong classification is made for vehicles passing on the closer lane.



	South-North (Sensor 1)	North-South (Sensor 2)
Sen. 1	87/88	91/99
Sen. 2	82/88	99/99

## Conclusion

The approach has been theoretically justified and proven to work well on real world data.