Identifying foreground objects from IP cameras

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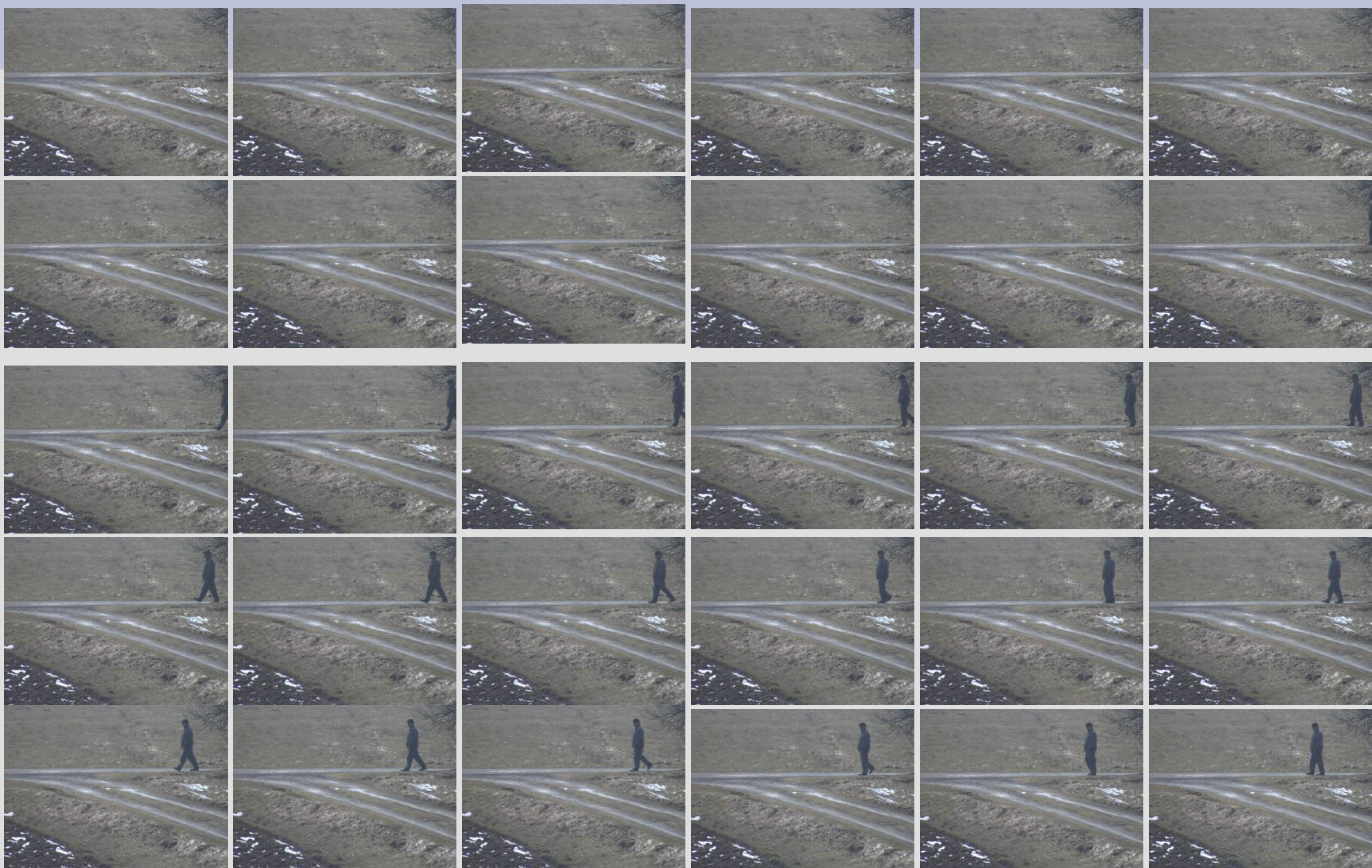
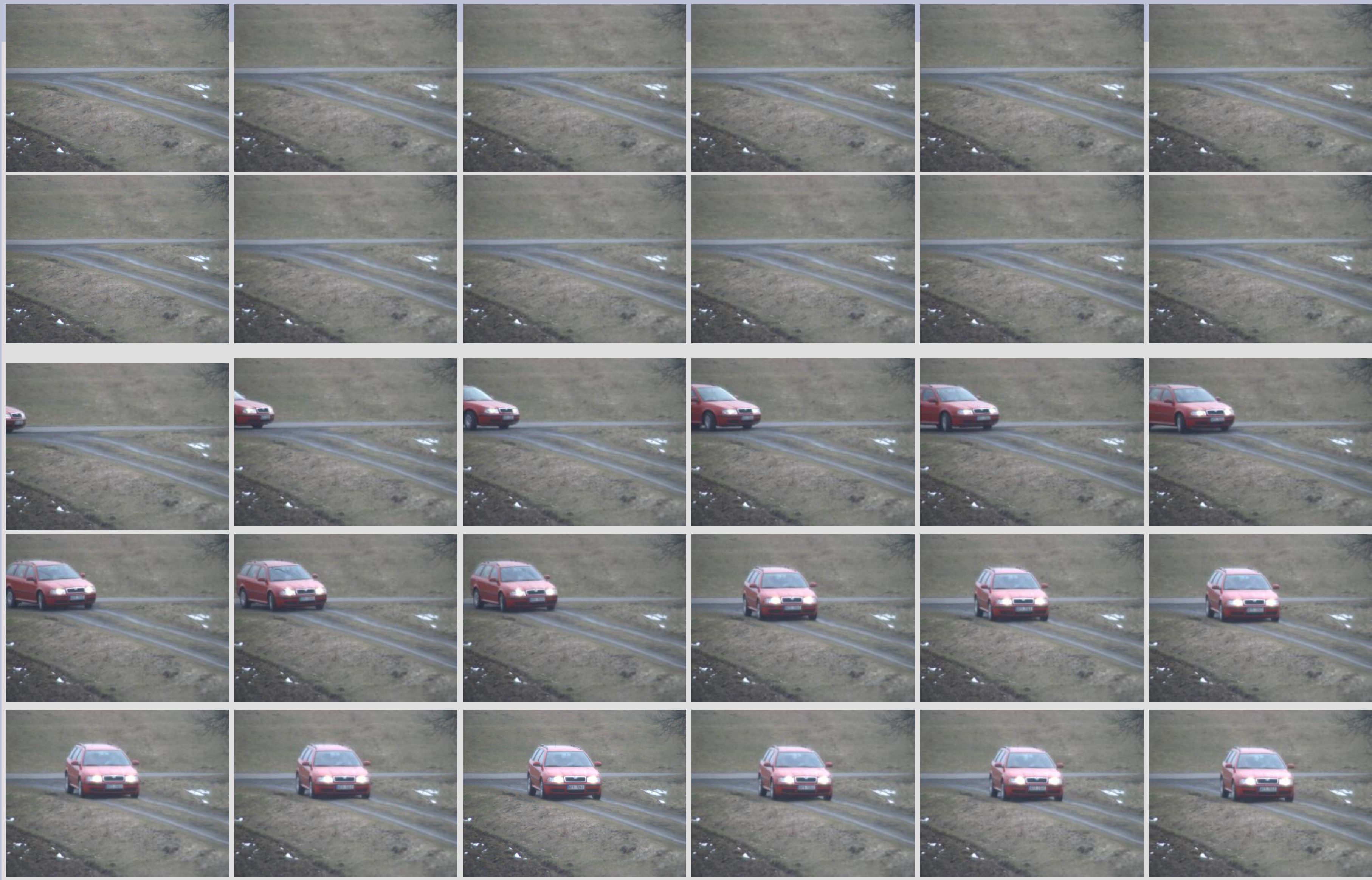
Typical records example

As these series of images look like?



Example with the car



Aim

- Recognizing foreground object in series of recorded images from IP cameras
- Verification using Gaussian mixture to separate the foreground with a small number of static background images
- Selection and testing classification methods

The conventional methods

- HOG –histogram of oriented gradient
- HAAR cascades
- PCA principal component analysis

Benefits

- detection from a single still image

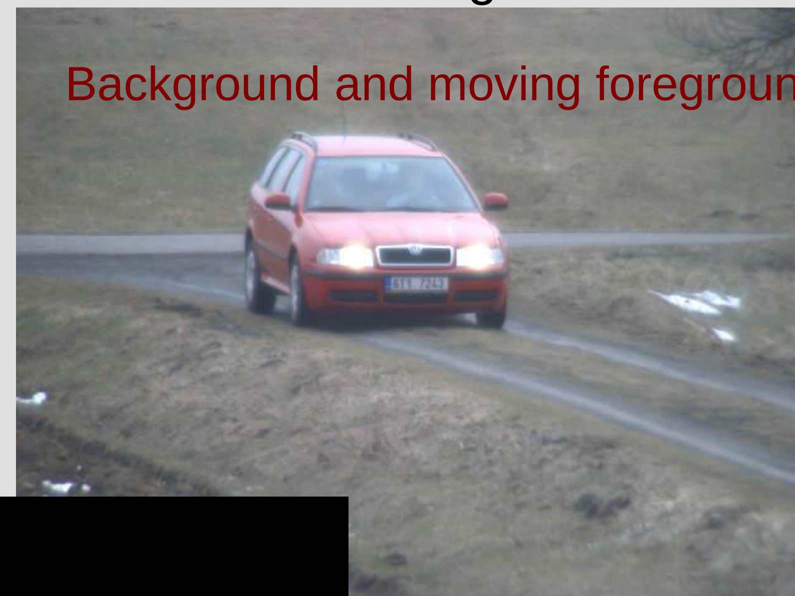
Disadvantages

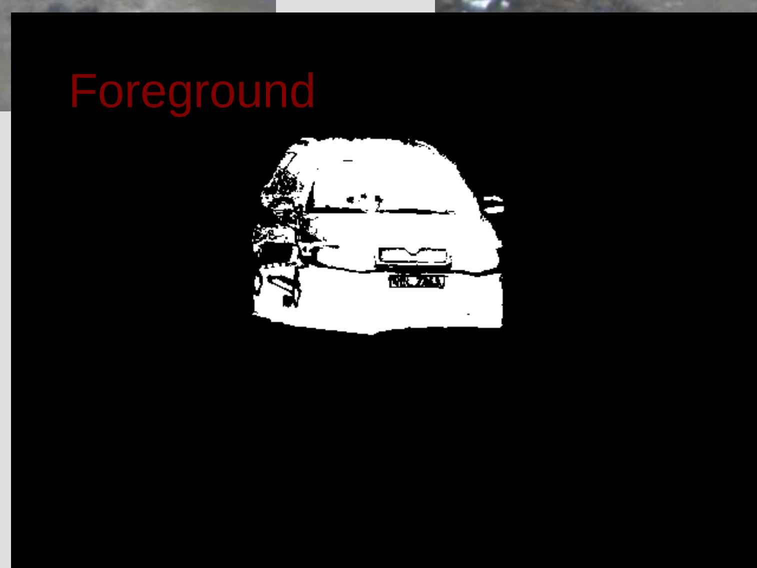
- high number of sample images - training data (in thousands)

Solution

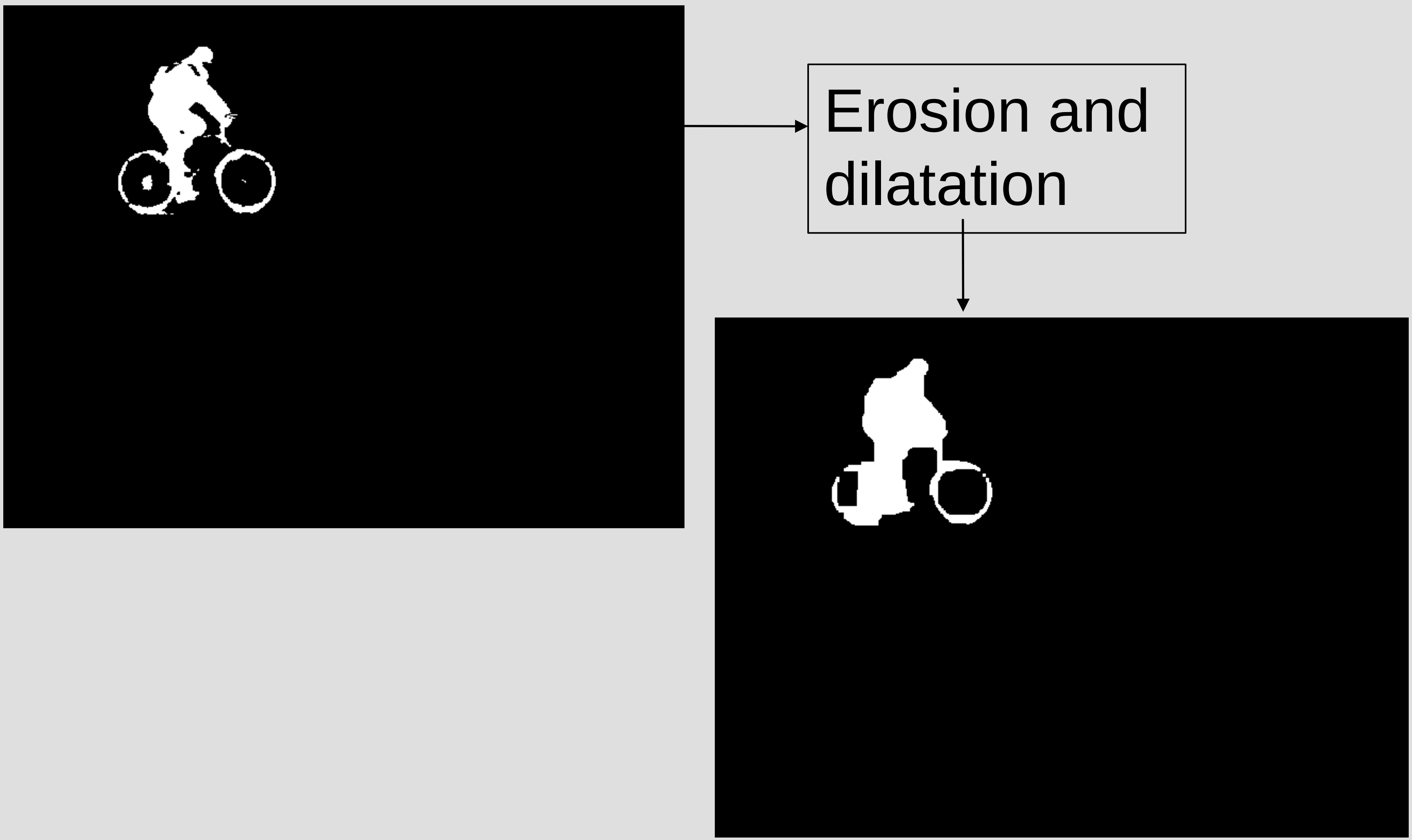
Segmentation of the scene in the foreground and background

- Mixture of Gaussians with little numbers of statical background





Removal of noise
suppression splitting of one object to more objects



Mathematical parametrization Normalized central moments

Geometric moments

$$m_{pq} = \sum_{x=0}^{X_{max}} \sum_{y=0}^{Y_{max}} x^p y^q f(x, y)$$

Center of gravity

$$\bar{x} = \frac{m_{10}}{m_{00}}$$

$$\bar{y} = \frac{m_{01}}{m_{00}}$$

Central moments

$$\mu_{pq} = \sum_{x=0}^{X_{max}} \sum_{y=0}^{Y_{max}} (x - \bar{x})^p (y - \bar{y})^q f(x, y)$$

Normalized central moments

$$\eta_{pq} = \frac{\mu_{pq}}{\mu_{pq}^{\gamma}} \qquad \gamma = \frac{p+q}{2} + 1 \; pro \; p+q = 2,3, \ldots$$

HU invariant moments

Non linear combination normalized central moments

$$\Phi_1 = \eta_{20} + \eta_{02}$$

$$\Phi_2 = (\eta_{20} - \eta_{02})^2 + 4\eta_{11}^2$$

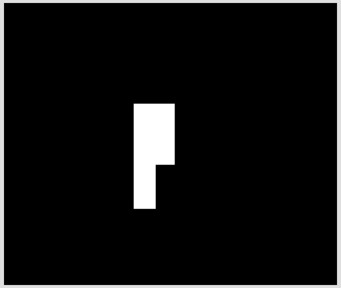
$$\Phi_3 = (\eta_{30} - 3\eta_{12})^2 + (3\eta_{21} - \eta_{03})$$

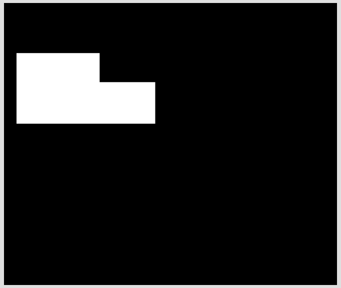
$$\Phi_4 = (\eta_{30} + \eta_{12})^2 + (\eta_{21} + \eta_{03})^2$$

$$\begin{aligned}\Phi_5 = &(\eta_{30} - 3\eta_{12})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2] \\ &+ (3\eta_{21} - \eta_{03})(\eta_{21} - \eta_{03})[3(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2]\end{aligned}$$

$$\Phi_6 = (\eta_{20} - \eta_{02})[(\eta_{30} - \eta_{12})^2 - (\eta_{21} + \eta_{03})^2] + 4\eta_{11}(\eta_{30} + \eta_{12})(\eta_{21} + \eta_{03})^2$$

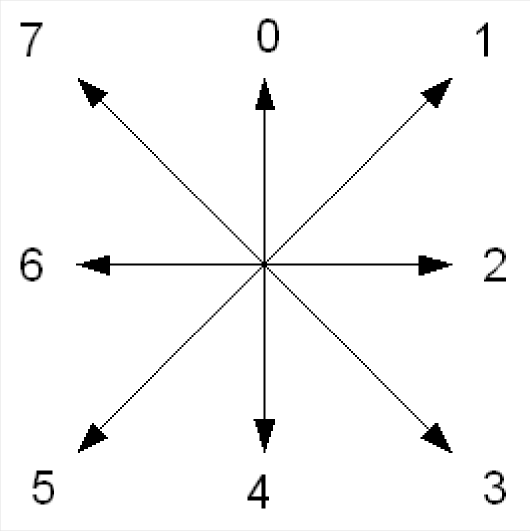
$$\begin{aligned}\Phi_7 = &(3\eta_{21} - \eta_{03})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2] \\ &+ (3\eta_{21} - \eta_{30})(\eta_{21} - \eta_{03})[3(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2]\end{aligned}$$

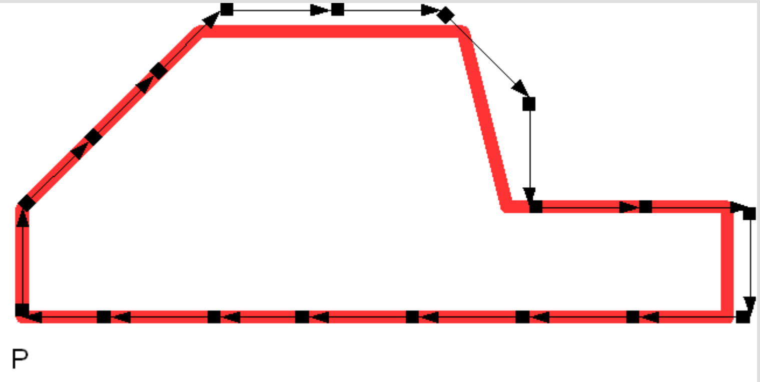




Freeman chain code

Edge presentation





[0,1,1,1,2,2,3,4,2,2,4,6,6,6,6,6,6,6]

The percentage results of the tested parametrization

Class	Normované centrální momenty	HU invariantn moments	Histogram Freeman code
CAR	98,2	95,7	60,6
SKEWCAR	89,9	91,5	98
CYCLIST	57,6	33,9	79,7
PERSONDOG	90	44	42,6
DOG	100	57,7	0
PERSON	94,6	91,5	25,1
GROUP	70,1	53,7	72
Totally correctly classified	**91,7**	**85,3**	**43,2**

The percentage results of the classifiers

Classifier **Class**	**Neurall networks**	**Normal Bayes classifier**	**Support vector machine**	**Linear discriminant analyse**
CAR	98,1	100	48,3	99,6
SKEWCAR	90,5	69,1	80,8	86,8
CYCLIST	58,6	27,6	0	58,6
PERSON-DOG	89,9	30,2	0	89,2
DOG	100	96,2	10,9	100
PERSON	94,7	96,7	81,7	74,1
GROUP	69,9	43,3	50,9	85,3

Totally correctly classified	**91,7**	**87,8**	**72,3**	**80**

Typical classification errors

Class	Wrong	Correctly
PERSONGOD	 	 
GROUP OF PERSONS	 	 
PERSON	 	 

Thank you for your attention