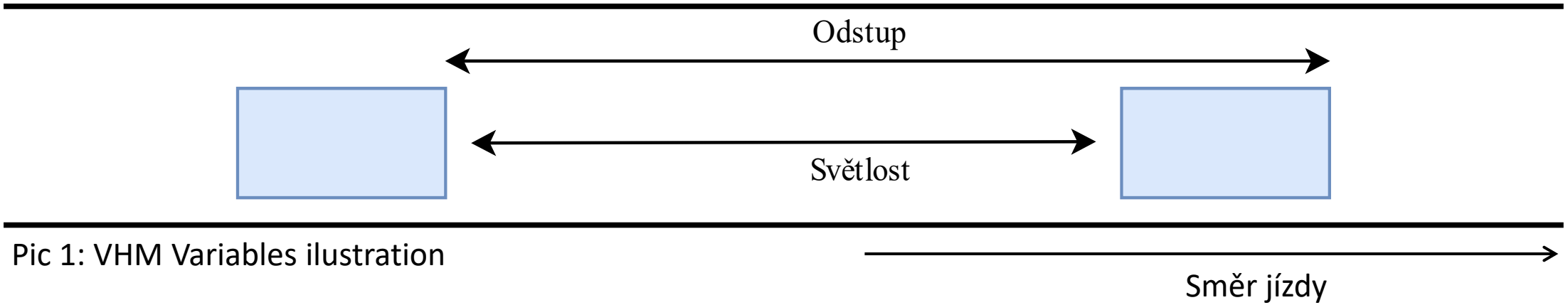
Superrandom states of thermodynamical traffic gas

Program

- Vehicular Headway Modeling (VHM)
- Thermodynamical traffic gas model
- Classification of particle systems states
- Superrandom traffic gas model

VHM – Vehicular Headway Modelling



Pic 1: VHM Variables ilustration

Macrovariables:

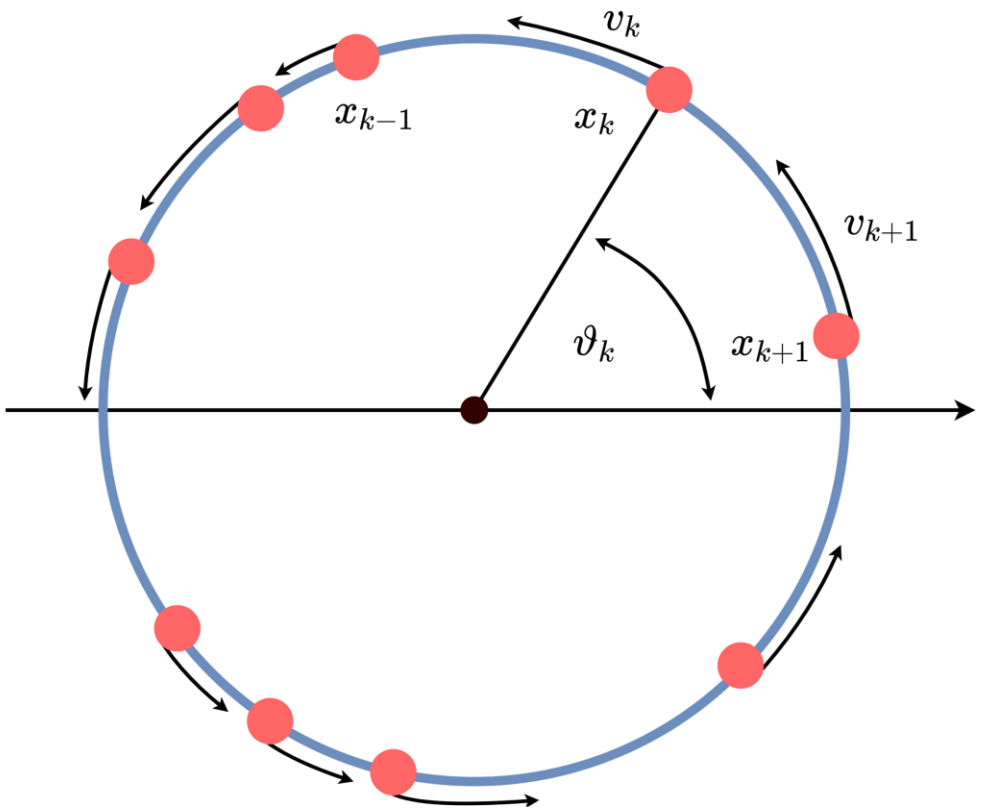
- Density
- Intensity
- Average speed

Microvariables:

- Individual speed
- Time and space headway
- Time and space clearance

Thermodynamical traffic gas model

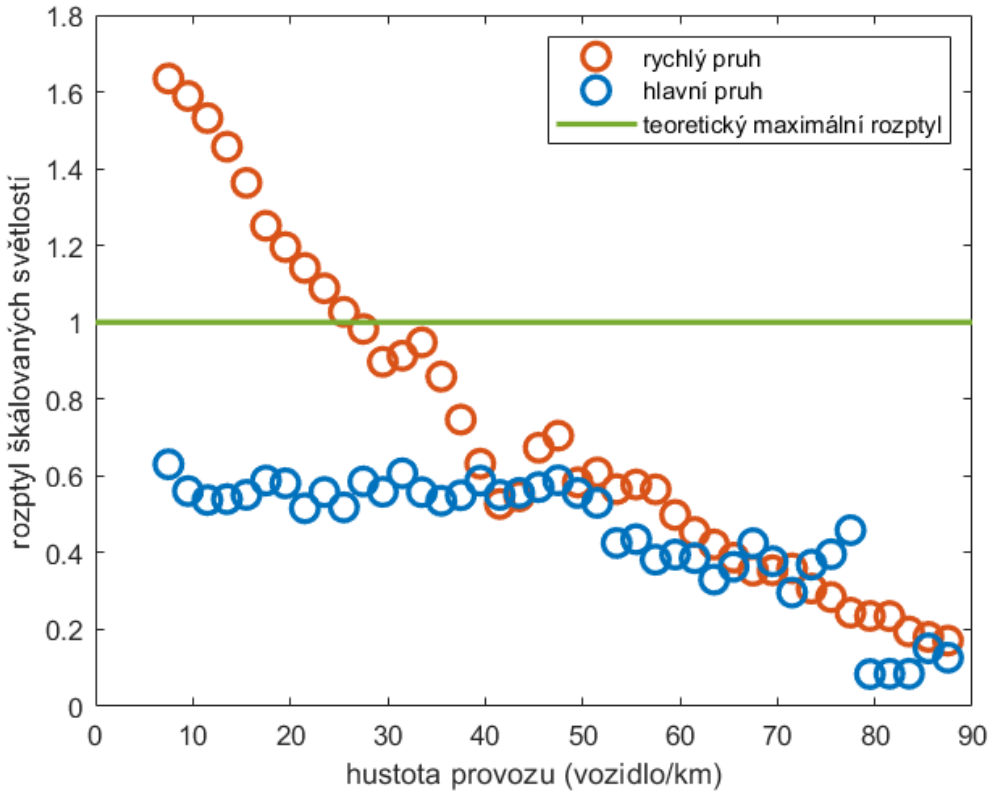
- Repulsive force
  - $F(r) = \frac{1}{r^{\gamma}} \quad , \gamma > 0$
  - $F(r) = -\frac{d\varphi}{dr}$
- Stacionary state
  - $U = \sum_{k=1}^{N}(\varphi_k) = const.$



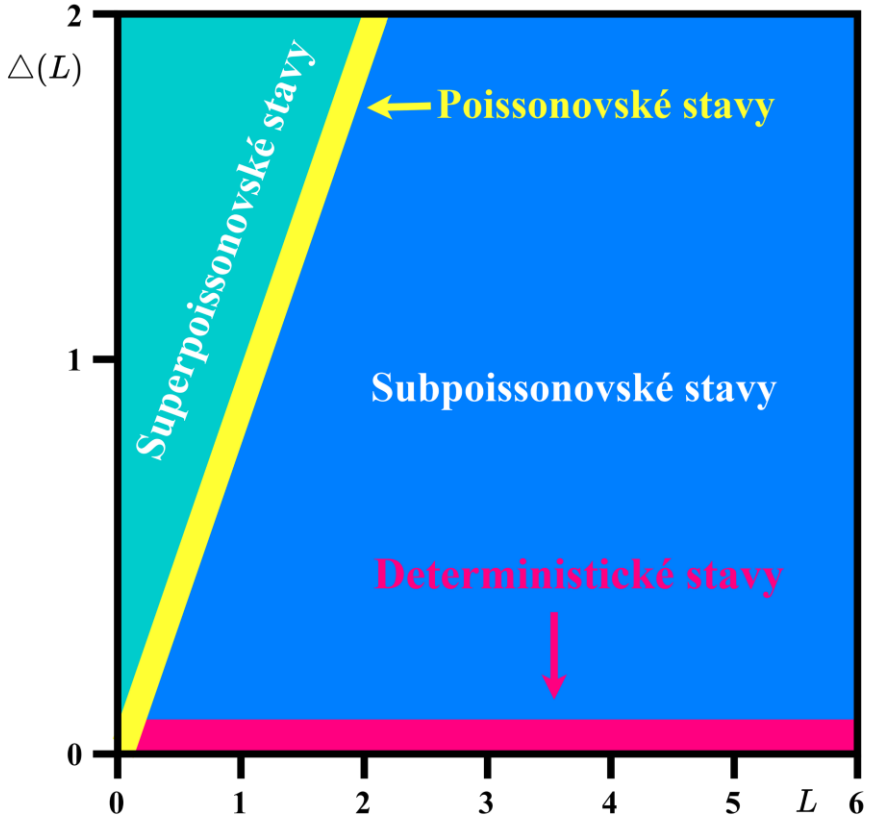
Pic 2: Particle gas on circle

Classification of states

$\Delta(L)$ - Statistic rigidity
L – interval length
Variance of clearances == direction of aproximation $\Delta(L)$



Pic. 3: Variance of clearances

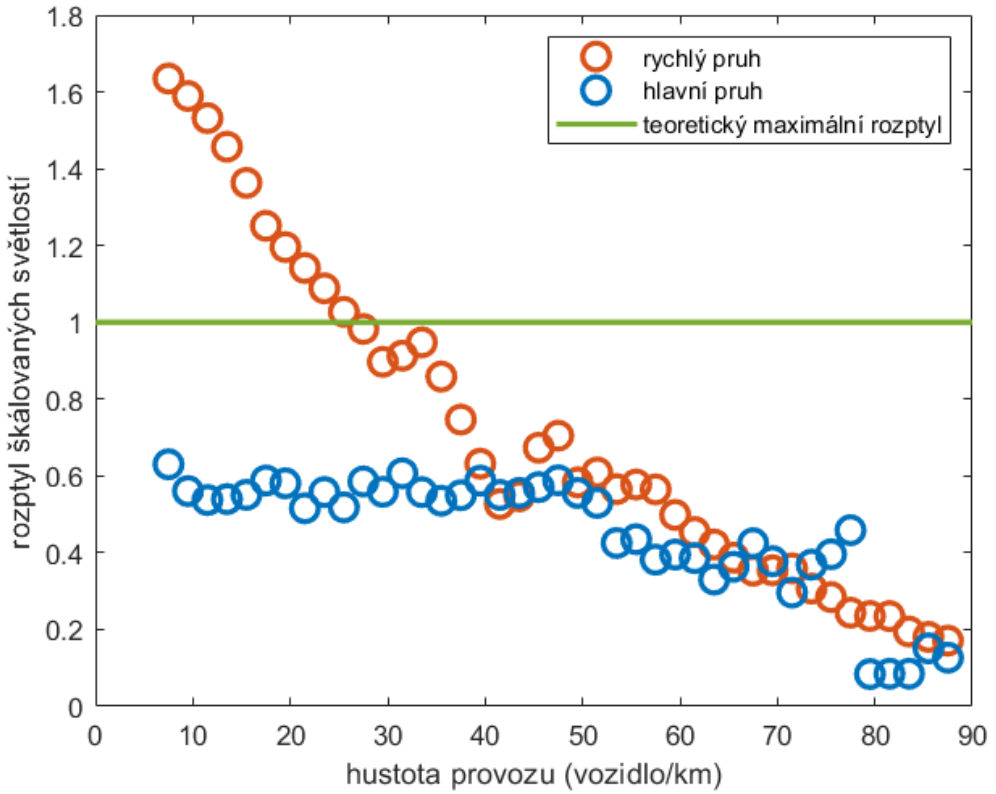


Pic. 4: Classification

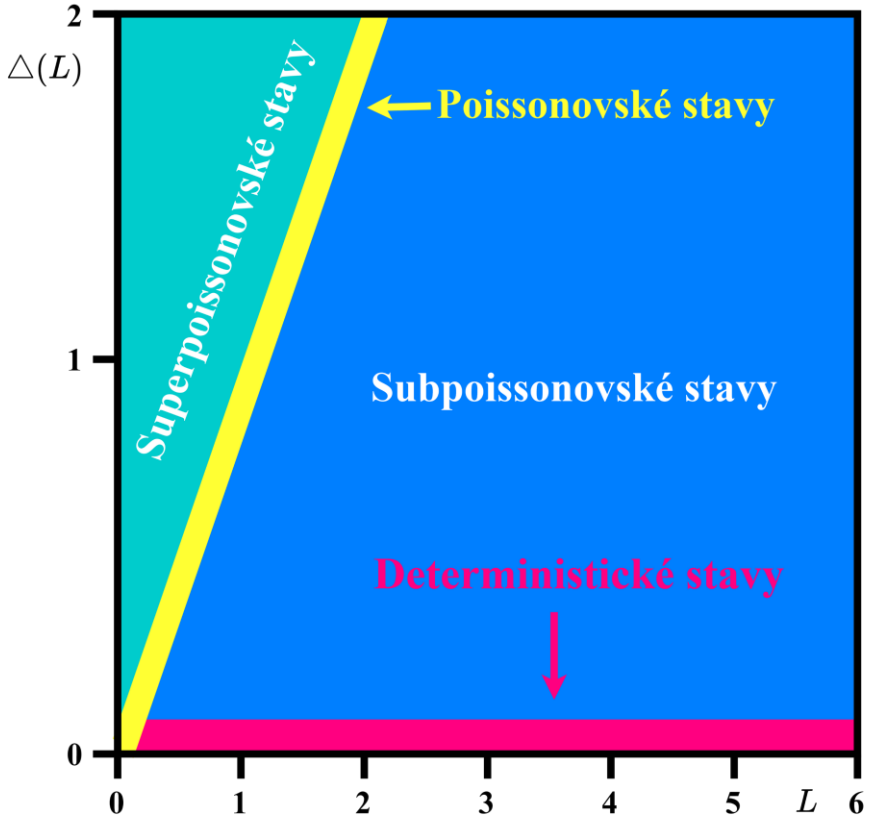
Who is responsible for that?

Classification of states

$\Delta(L)$ - Statistic rigidity
L – interval length
Variance of clearances == direction of aproximation $\Delta(L)$



Pic. 3: Variance of clearances



Pic. 4: Classification

Superrandom type of thermodynamical gas

GIG density

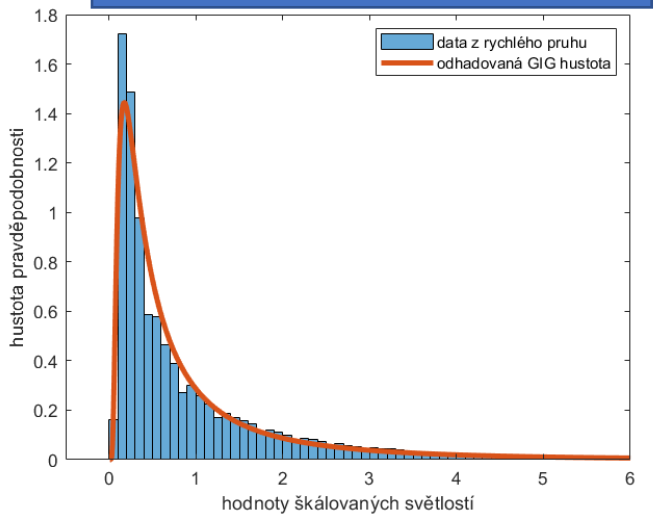
$$g(x) = \frac{1}{2}\left(\frac{\lambda}{\beta}\right)^{\frac{\alpha+1}{2}} \frac{x^{\alpha} e^{-\beta/x} e^{-\lambda x}}{K_{\alpha+1}(2\sqrt{\beta\lambda})}$$

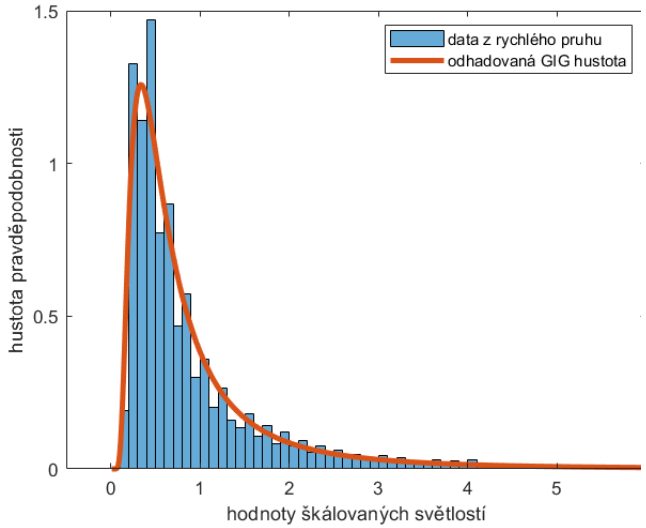
Combined power potencial

$$\varphi(x) = \kappa \ln x + \frac{1}{x}$$

- $\kappa \ln x \rightarrow$ attractive part
- $\frac{1}{x} \rightarrow$ repulsive part
- $\kappa \rightarrow$Power coefficient

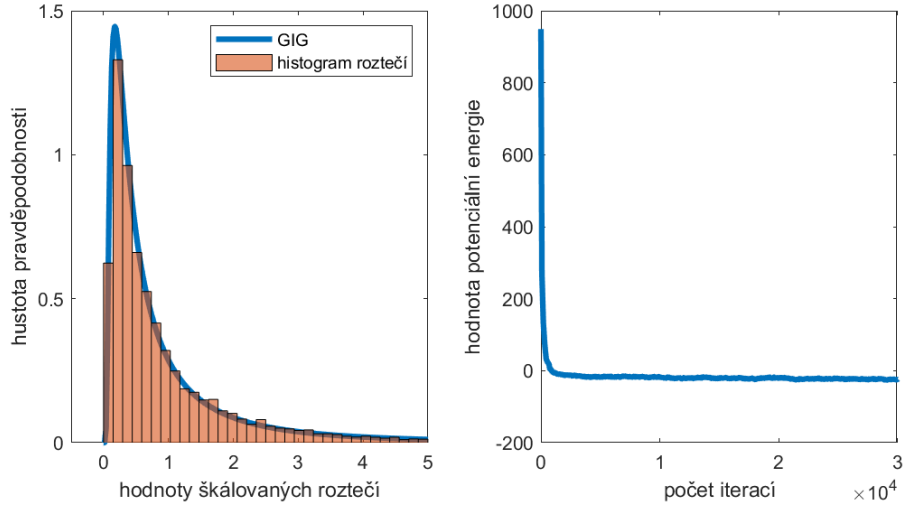
Empirical data

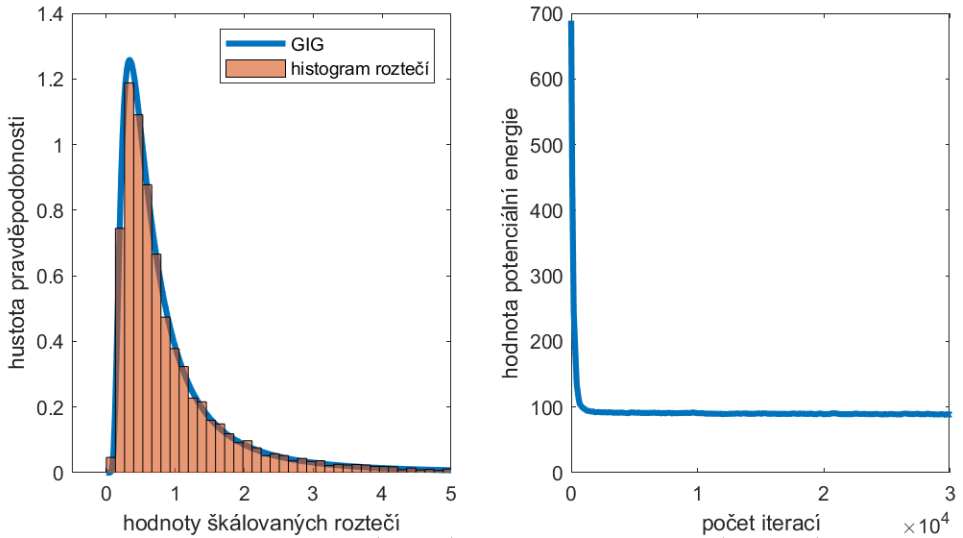




higher pic. $\varrho \in (5,10)$, lower pic. $\varrho \in (13,17)$

Simulated data



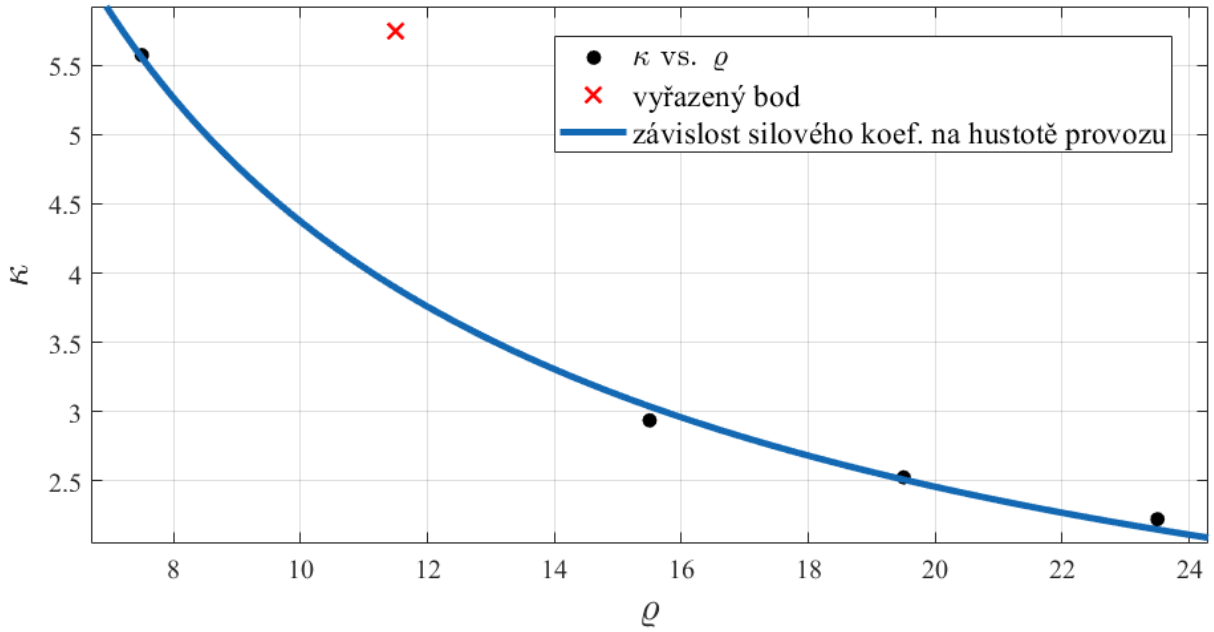


higher pic. $\varrho \in (5,10)$, lower pic. $\varrho \in (13,17)$

Power coefficient vs density

interval hustoty	(5,10)	(9,14)	(13,18)	(17,22)	(21,26)
α	-1.5940	-1.2485	-2.733	-3.1367	-3.6271
β	0.2860	0.2172	0.9303	1.2416	1.6303
λ	0.2294	0.1550	0.0718	0.0419	0.0013
κ	5.5734	5.7482	2.9378	2.5263	2.2248
rozptyl simulace	1.5180	1.3559	1.2263	0.9559	0.9462
rozptyl empirický	1.6349	1.5318	1.3632	1.1960	1.0886

Tab. 1: parametres of model and variances



Pic 5: Power coefficient vs density

Zdroje

- [1] *Supernáhodné stavy v automobilové dopravě: příčiny a důsledky, M. Krbálek*
- [2] *3s-Unification for Vehicular Headway Modelling, M. Krbálek, M. Krbálková*