МЕРЕЊА У ХИДРОТЕХНИЦИ

Хидротехничка форензика: сензор раздаљине + модел крутог удара

Студент:
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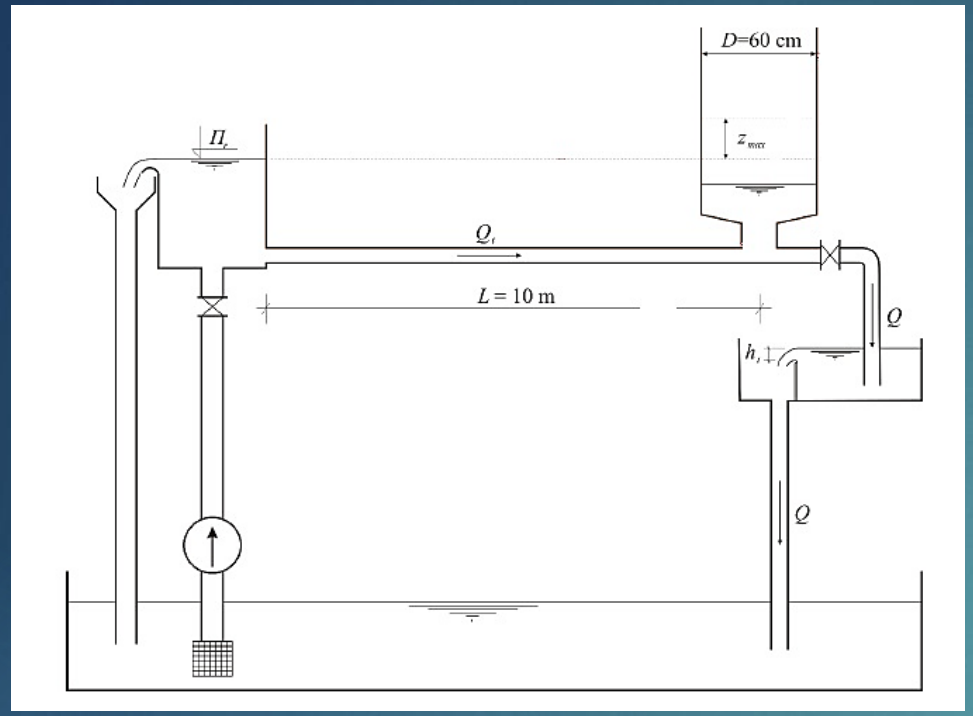
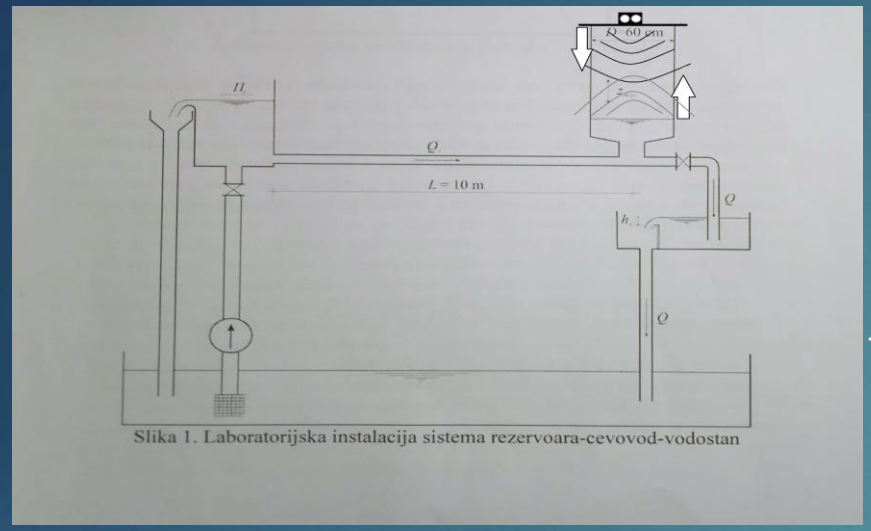


D, λ, ξ_p = ?

Мерење и обрада резултата

- Одабир опреме
- Калибрација
- Монтажа
- Уклањање шума – MOVING AVERAGE
- Модел крутог удара
- Поређење резултата – RMSE и SOLVER

Ултразвучни сензор раздаљине HC-SR04

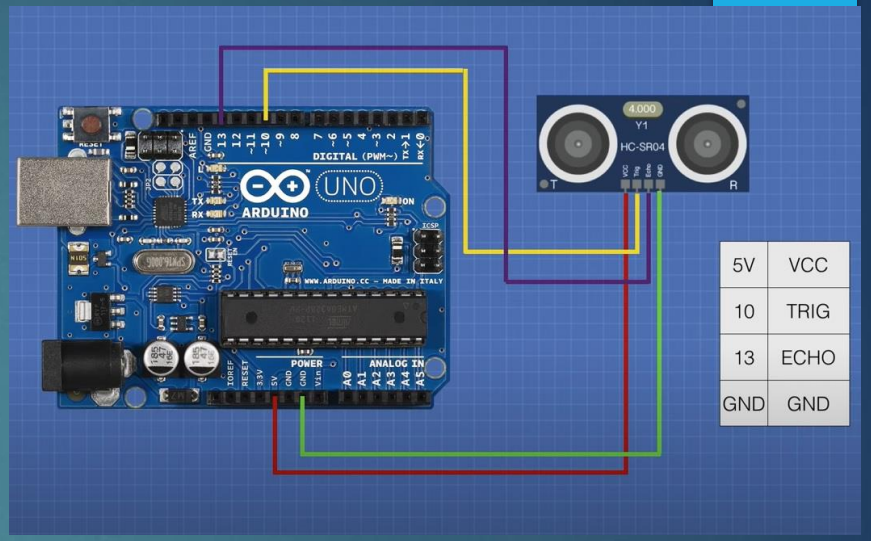


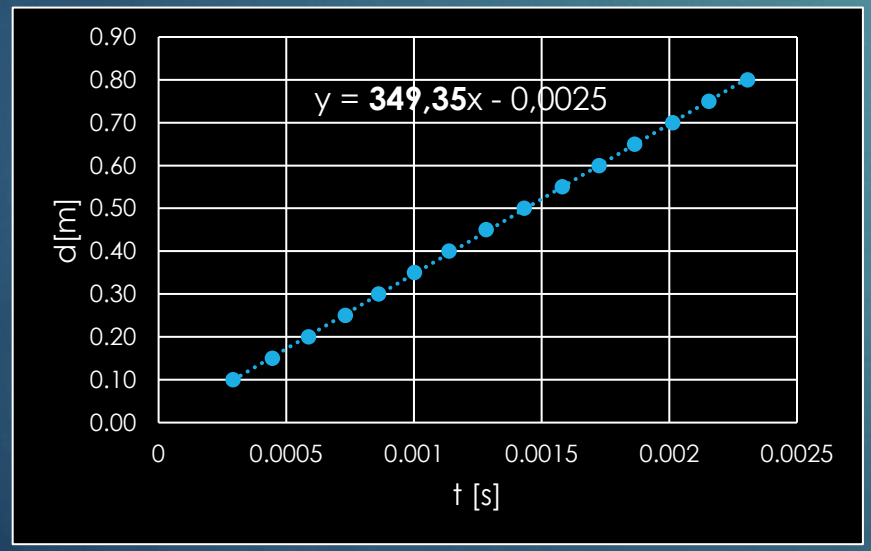
Slika 1. Laboratorijska instalacija sistema rezervoara-cevovod-vodostan

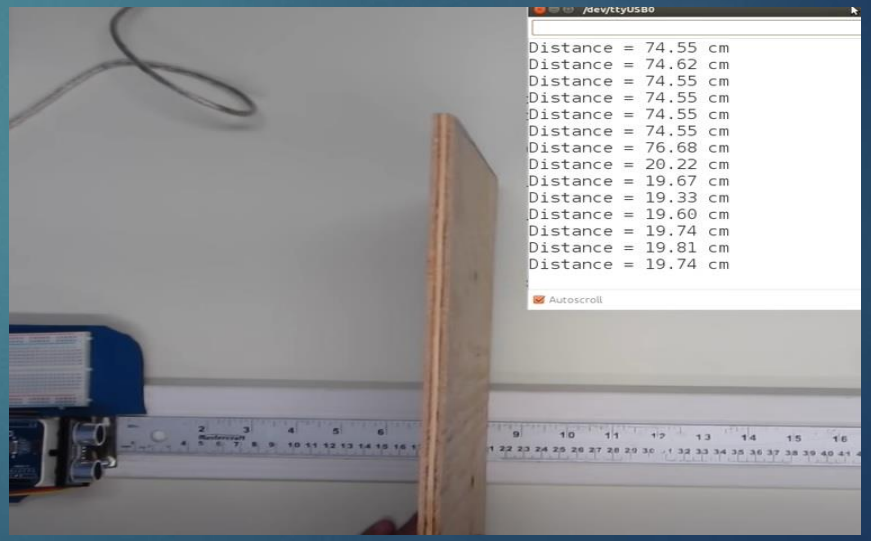
$$d = \frac{\Delta t}{2} * C$$

$$f_{uz} > 2 * fmax$$

$$f_{uz} = \frac{1}{\Delta t}$$





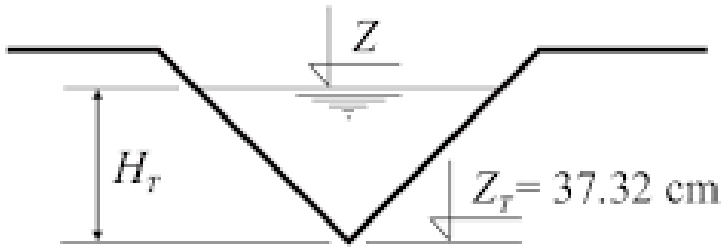


Модел крутог удара

$$\frac{dQ_T}{dt} = \frac{gA_T}{L}\left(-Z_V - \xi_{PR}\frac{Q_V|Q_V|}{2gA_{PR}^2}\right) - \frac{2\lambda}{\pi D^3}Q_T|Q_T|$$

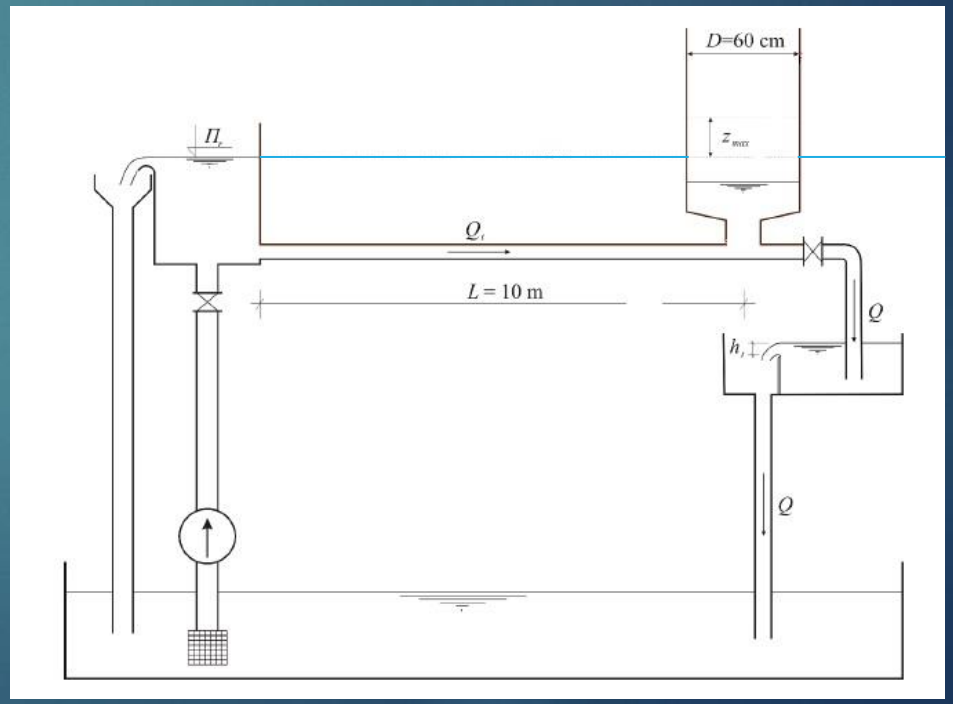
$$\frac{Q_T^{n+1} - Q_T^n}{\Delta t} = \frac{gA_T}{L}\left(-\frac{Z_V^{n+1} + Z_V^n}{2} - \xi_{PR}\frac{Q_V^n|Q_V^n|}{2gA_{PR}^2}\right) - \frac{2\lambda}{\pi D^3}Q_T^n|Q_T^n|$$

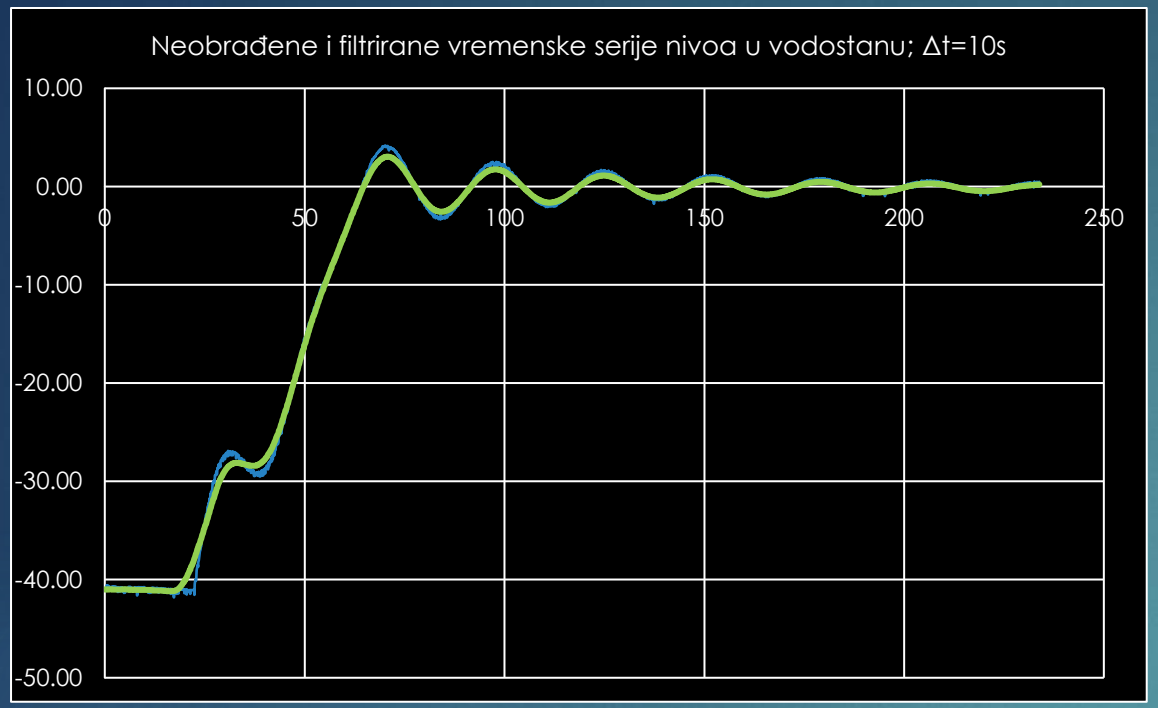
Томсонов прелив

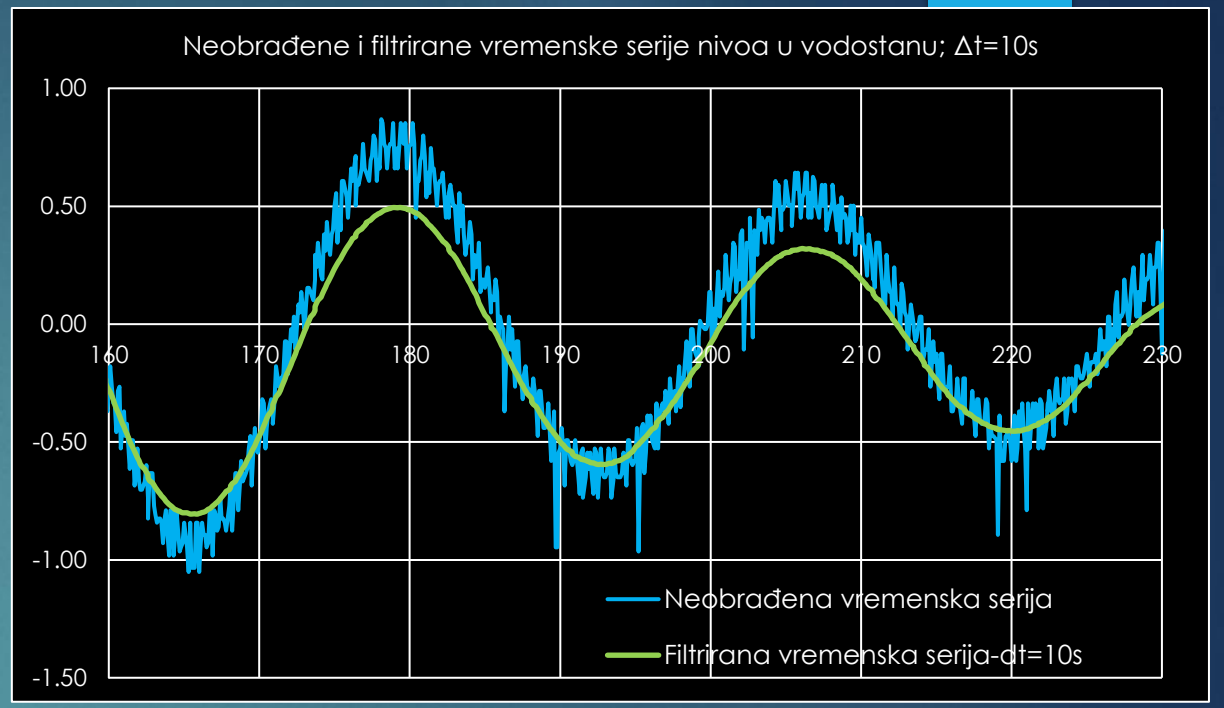


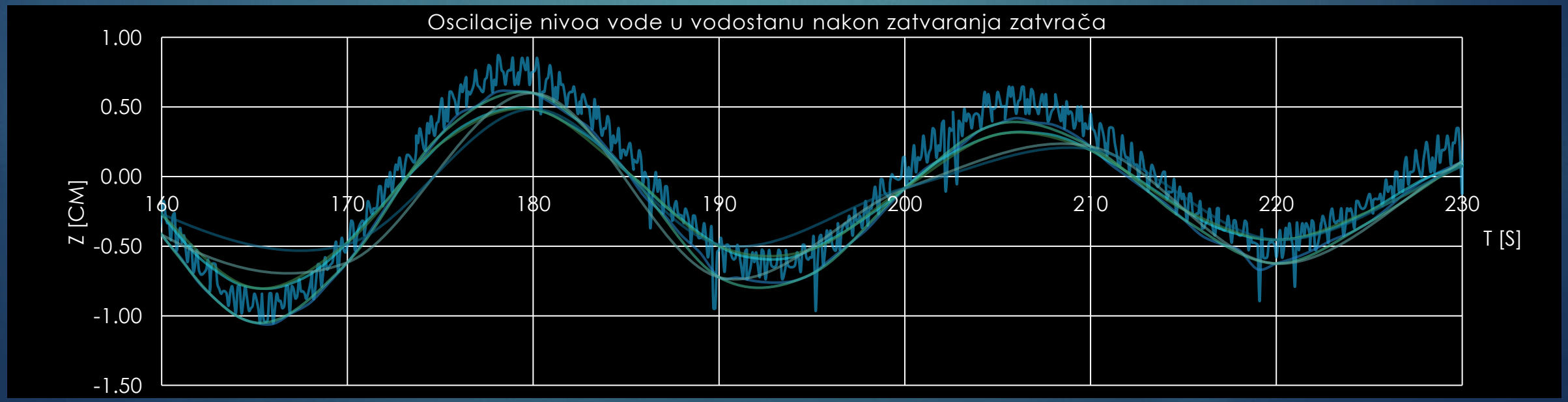
$$Q_T = \frac{8}{15}\cdot m \cdot \sqrt{2g \cdot H_T^5} \;;\quad m = 0.585$$

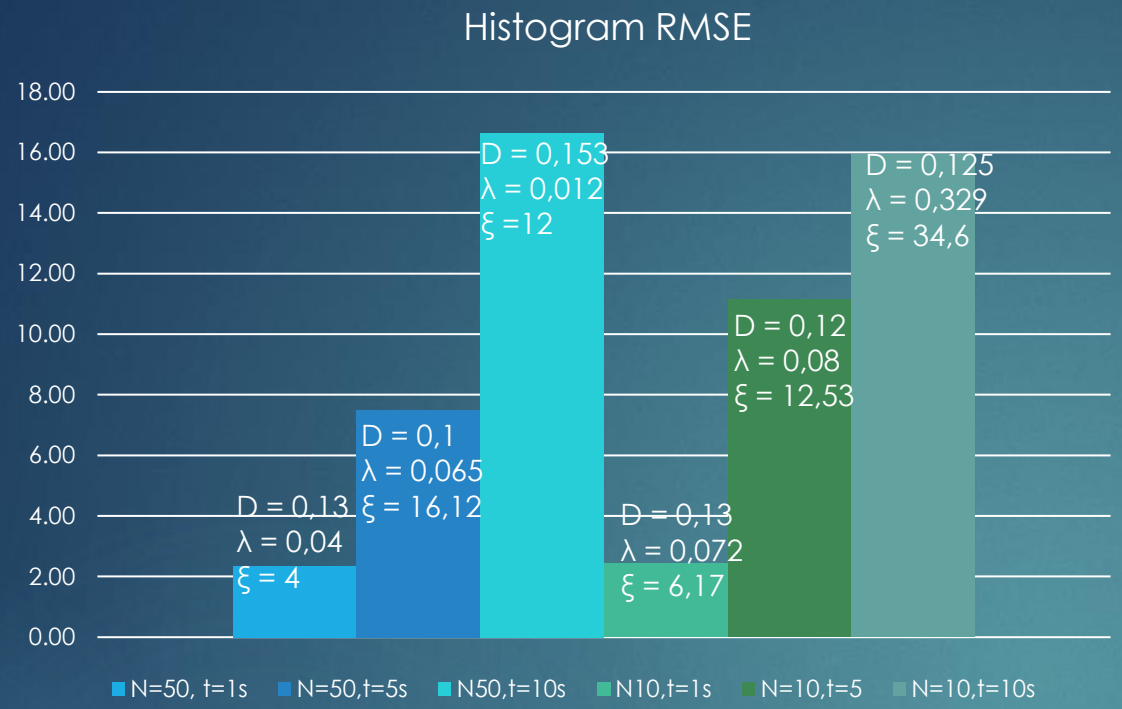
$$H_T = Z - Z_T$$

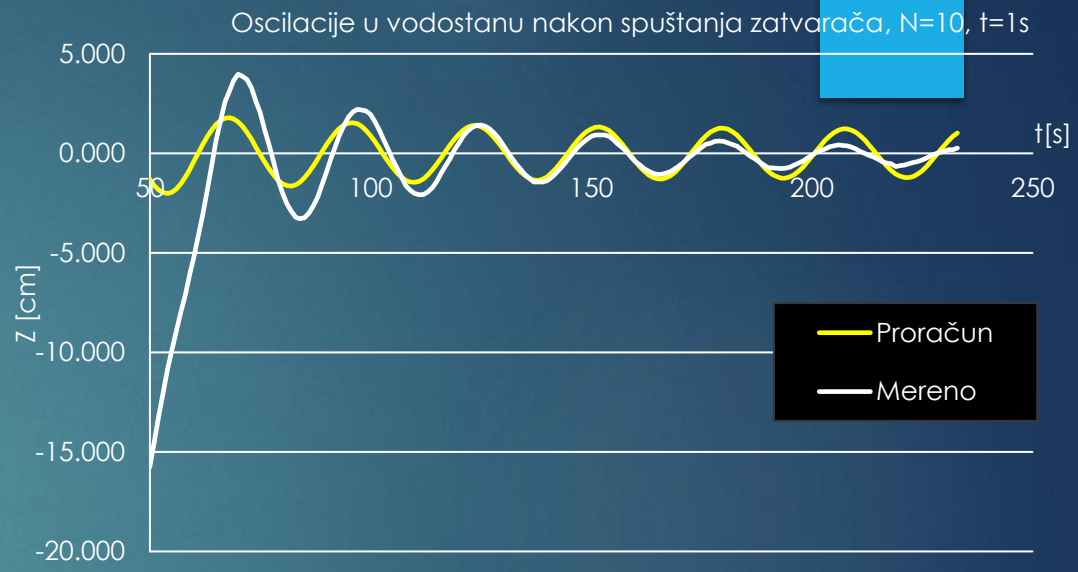


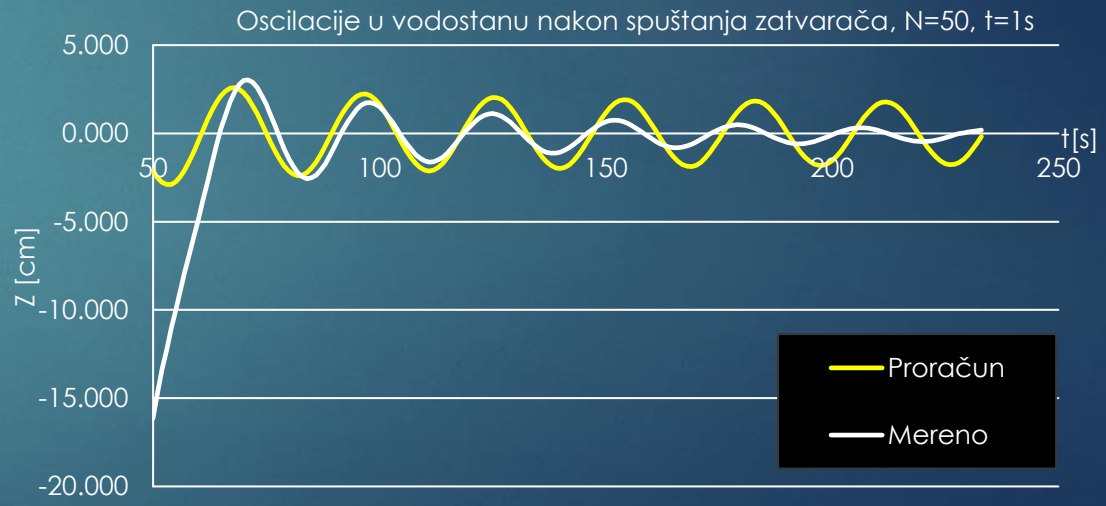

Neobrađene i filtrirane vremenske serije nivoa u vodostanu; Δt=10s
10.00
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
0
50
100
150
200
250


Neobrađene i filtrirane vremenske serije nivoa u vodostanu; Δt=10s
1.00
0.50
0.00
-0.50
-1.00
-1.50
160
170
180
190
200
210
220
230
Neobrađena vremenska serija
Filtrirana vremenska serija-dt=10s


Oscilacije nivoa vode u vodostanu nakon zatvaranja zatvrača
1.00
0.50
0.00
-0.50
-1.00
-1.50
Z [CM]
160
170
180
190
200
210
220
230
T [S]


Histogram RMSE
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
D = 0,13
λ = 0,04
ξ = 4
D = 0,1
λ = 0,065
ξ = 16,12
D = 0,153
λ = 0,012
ξ =12
D = 0,13
λ = 0,072
ξ = 6,17
D = 0,12
λ = 0,08
ξ = 12,53
D = 0,125
λ = 0,329
ξ = 34,6
N=50, t=1s
N=50,t=5s
N50,t=10s
N10,t=1s
N=10,t=5
N=10,t=10s


Oscilacije u vodostanu nakon spuštanja zatvarača, N=10, t=1s
5.000
0.000
-5.000
-10.000
-15.000
-20.000
Z [cm]
50
100
150
200
250
t[s]
Proračun
Mereno


Oscilacije u vodostanu nakon spuštanja zatvarača, N=50, t=1s
5.000
0.000
-5.000
-10.000
-15.000
-20.000
Z [cm]
50
100
150
200
250
t[s]
Proračun
Mereno