

Kunstlihaste kontroll soojusvõrrandi abil

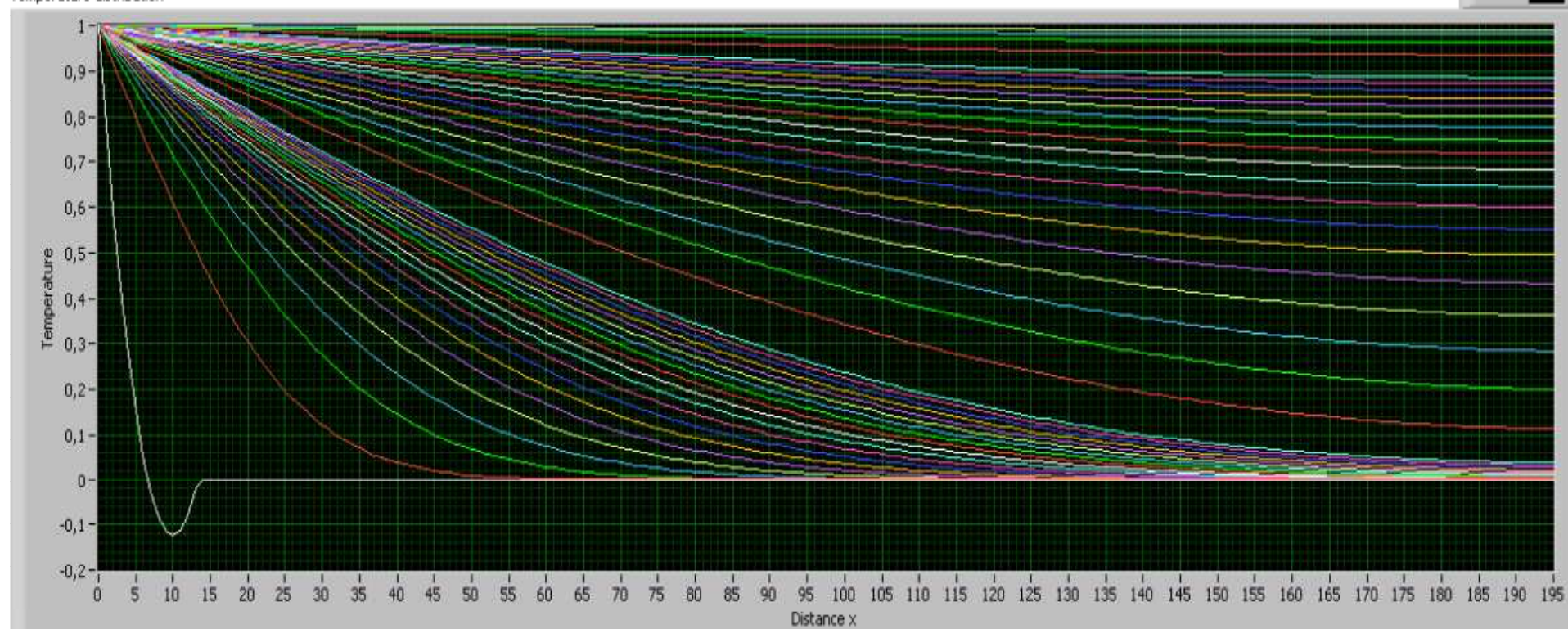
Indrek Must
29.03.10

- Soojusvõrrandist
- Lihased ja sojusvõrrandid
- Senised eksperimendid ja tulemused
- Probleemid

Soojusvõrrand

$$\frac{\partial u}{\partial t} = \kappa \frac{\partial^2 u}{\partial x^2}$$

Temperature distribution



SV ja kunstlihased

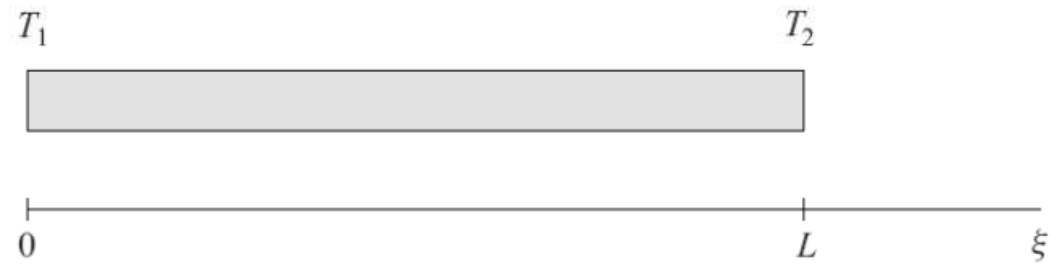
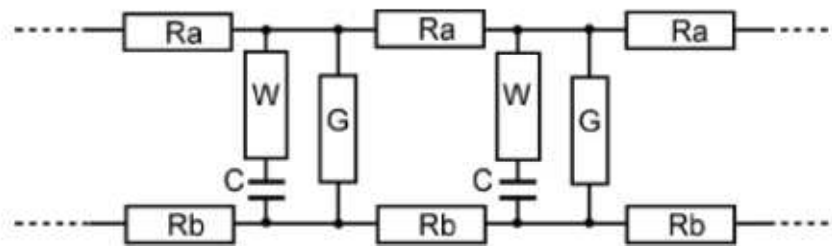
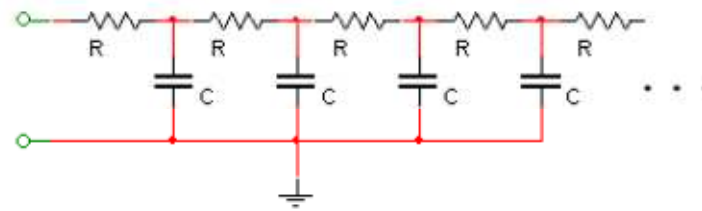


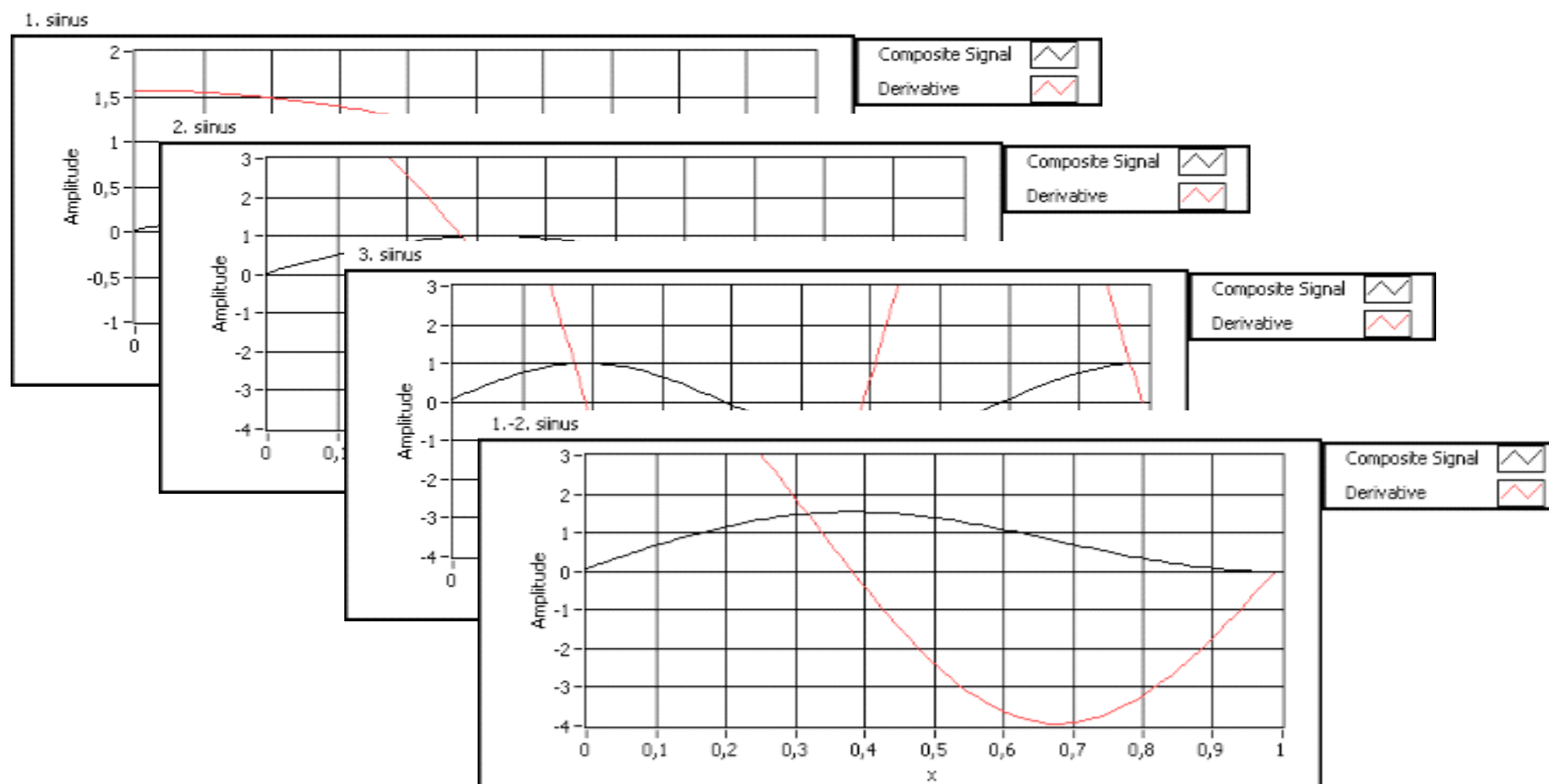
Figure 2.1. *A thermally conducting rod.*



Pinge/kõveruse jaotused

- Siinusekujulised pingejaotused

IMA Journal of Applied Mathematics (1982) 28, 93–105

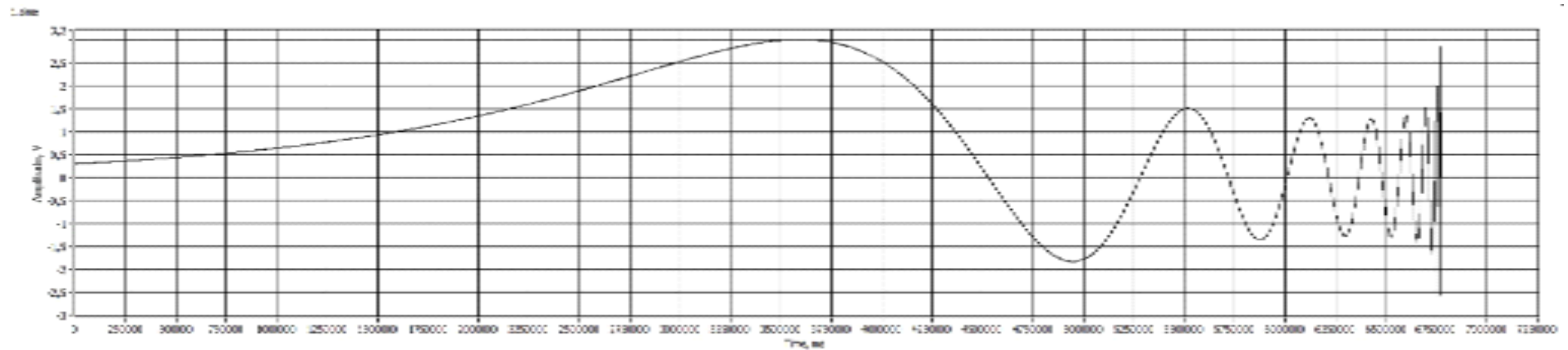
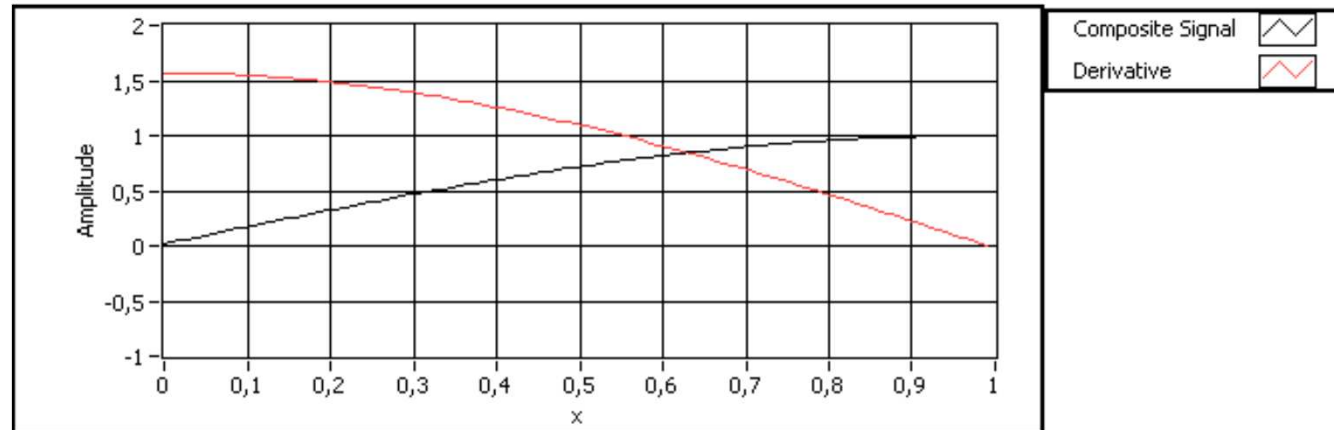


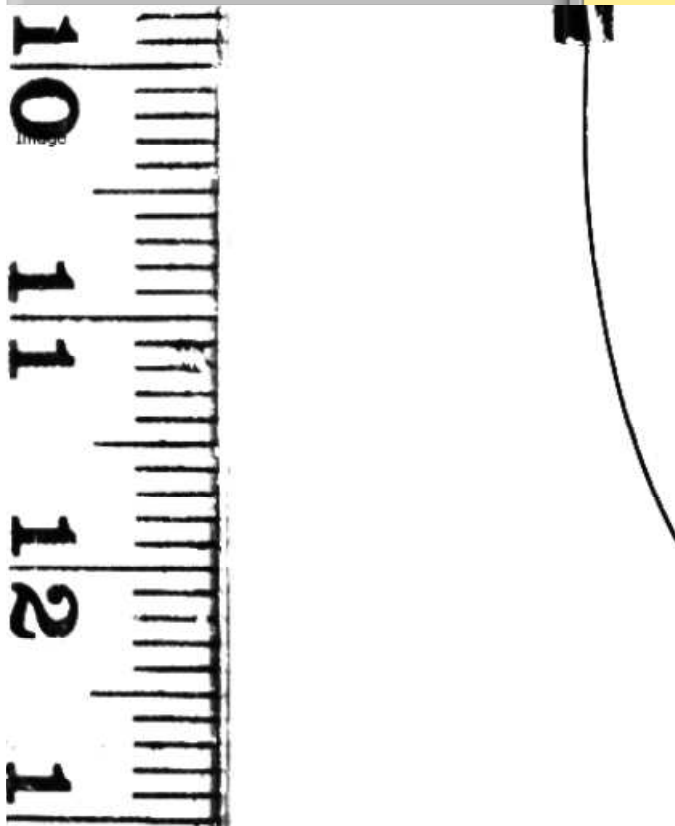
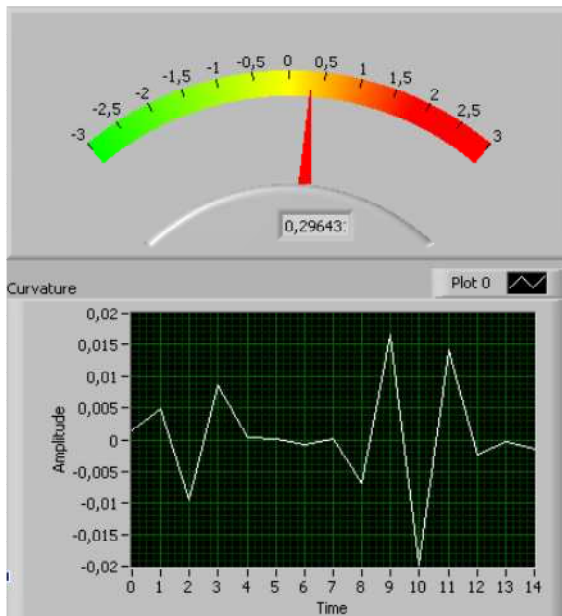
Math

- Vaja teada lihase elektrilisi parameetreid
- lihas “F7” (seni parim)
 - Aktiveeritud aerogeel (30 massi% aerogeeli)
 - Enne pressimist membraan 84μm, elektrood 89μm. Pärast pressimist 230μm.
 - Mõõdud: 20*1 mm
 - $C = 17.5 \text{ mF}$
 - $R_s = (975+500) = 1475 \text{ } \Omega/\text{cm}$

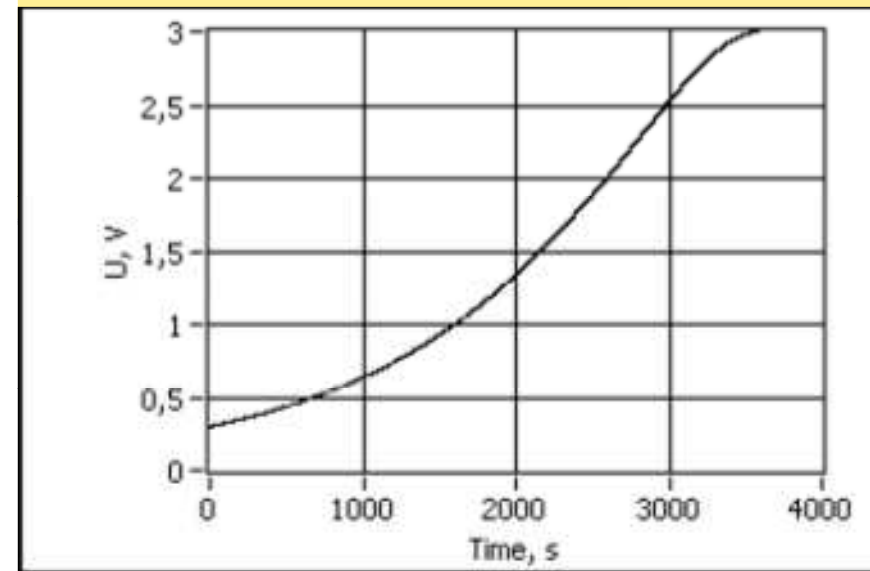
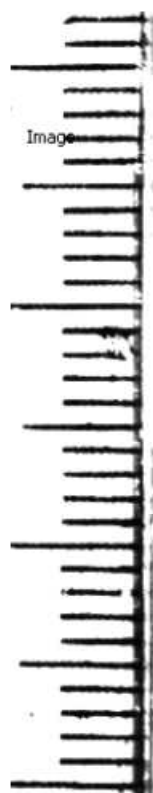
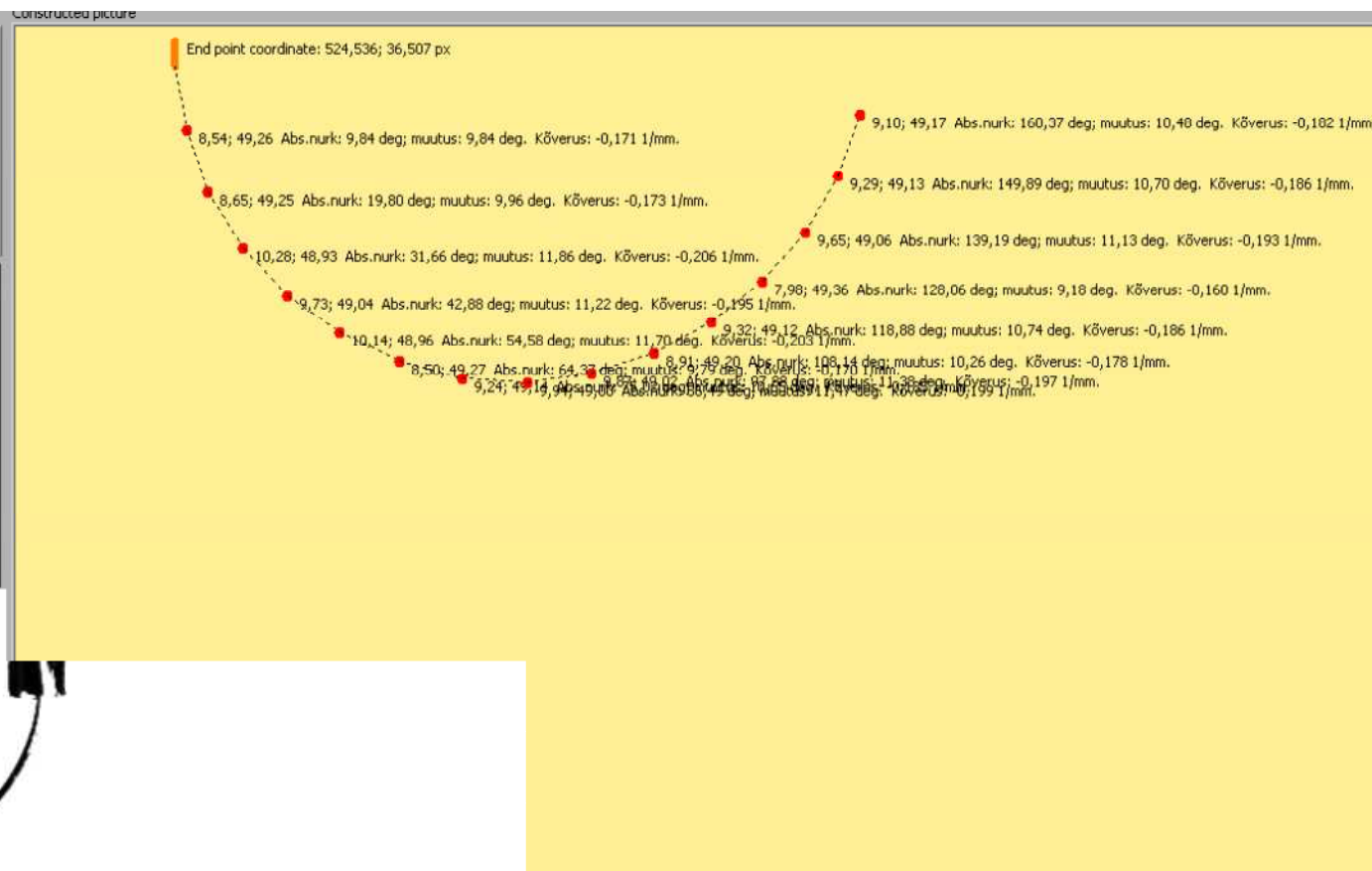
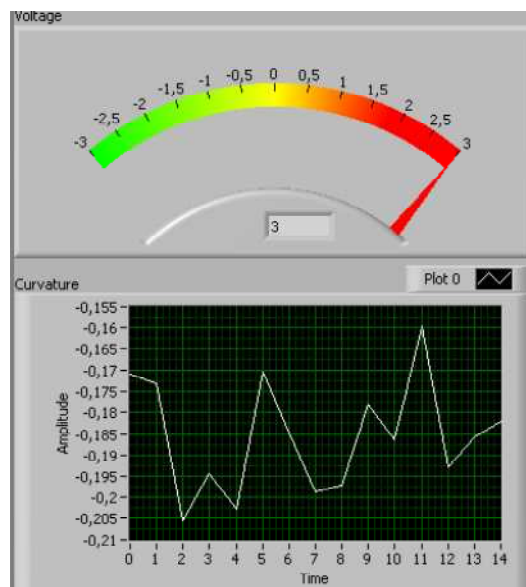
Math

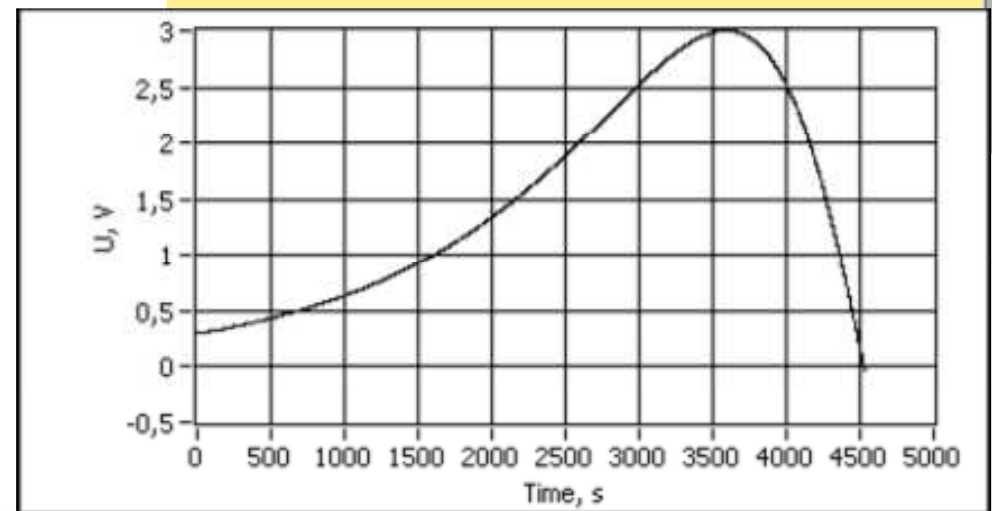
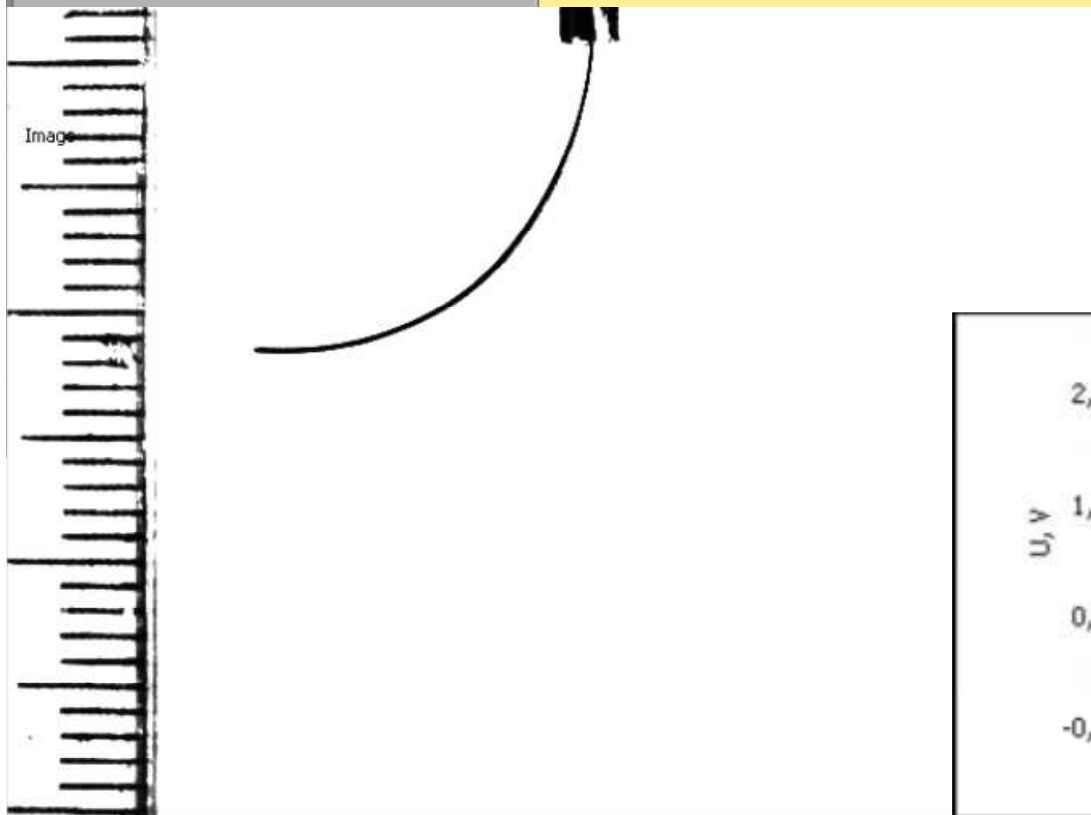
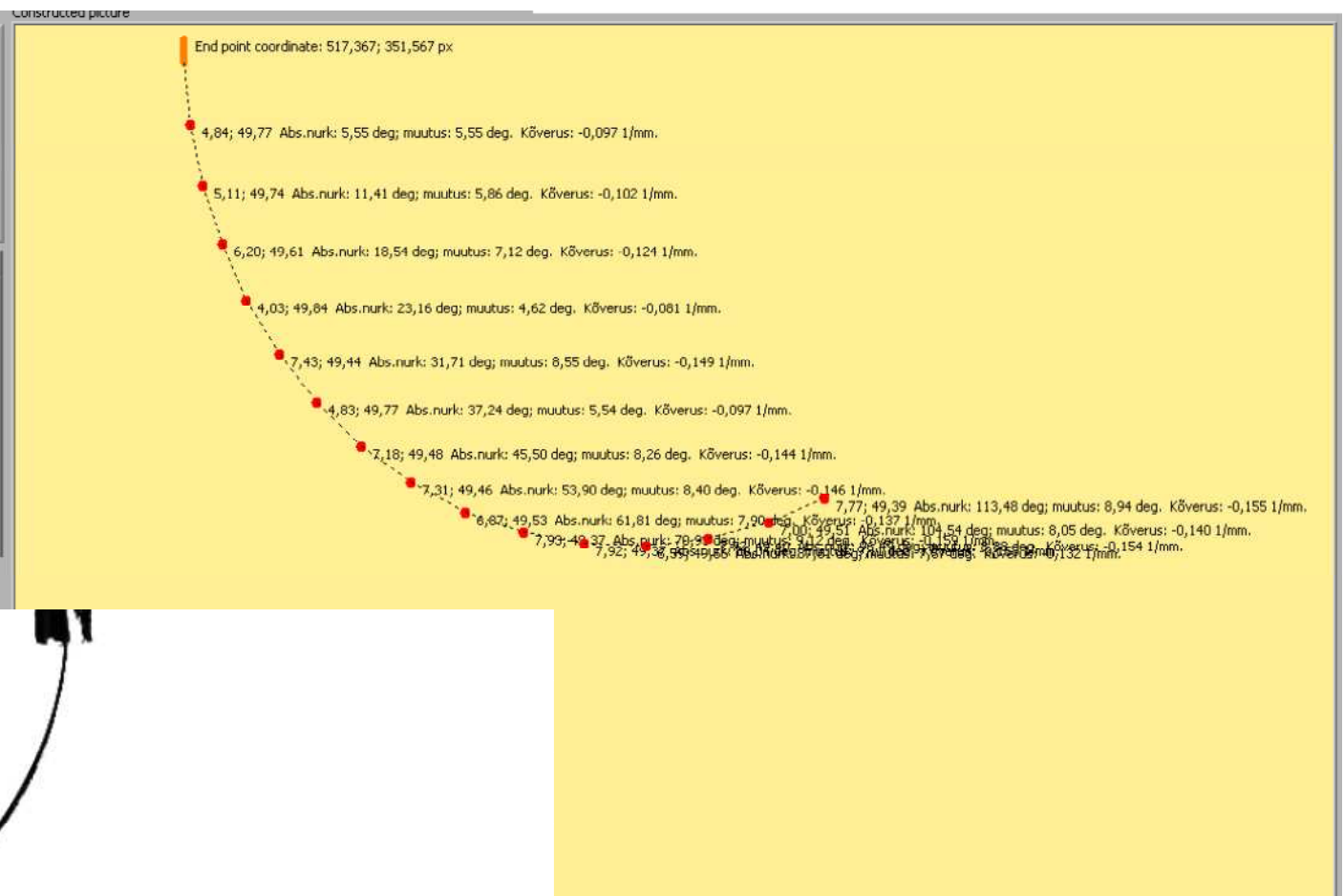
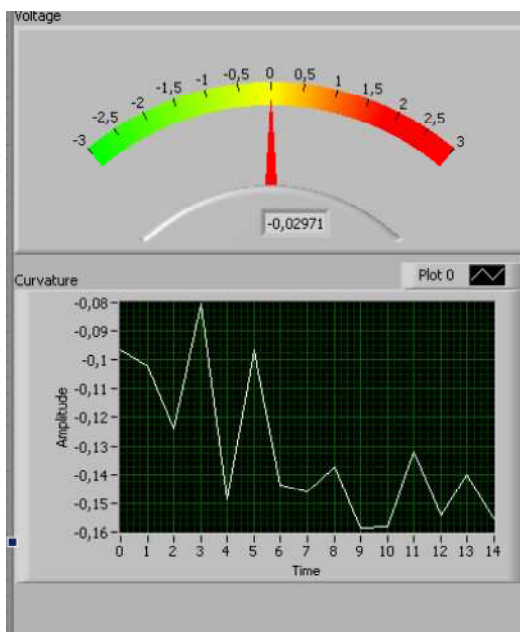
1. sinus

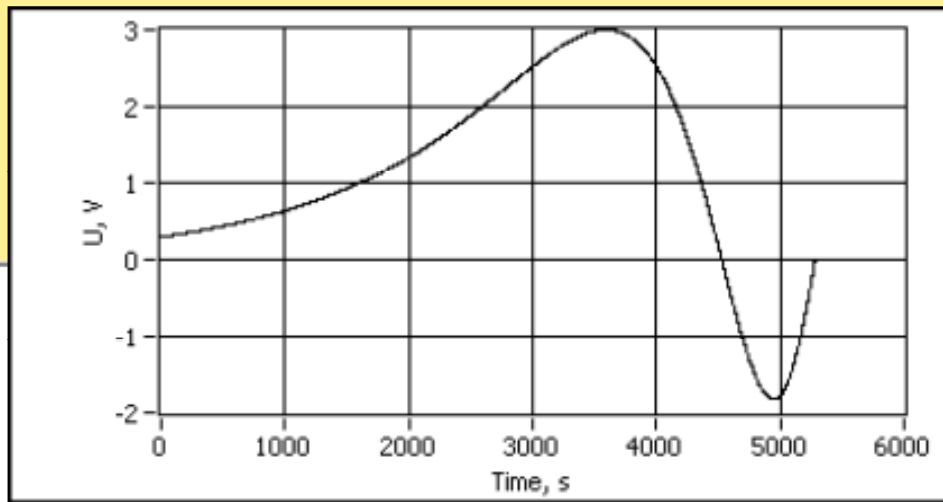
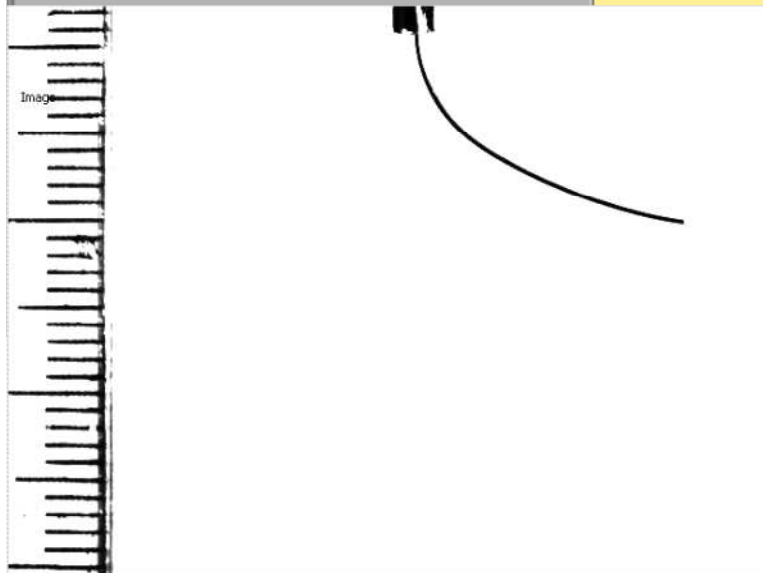
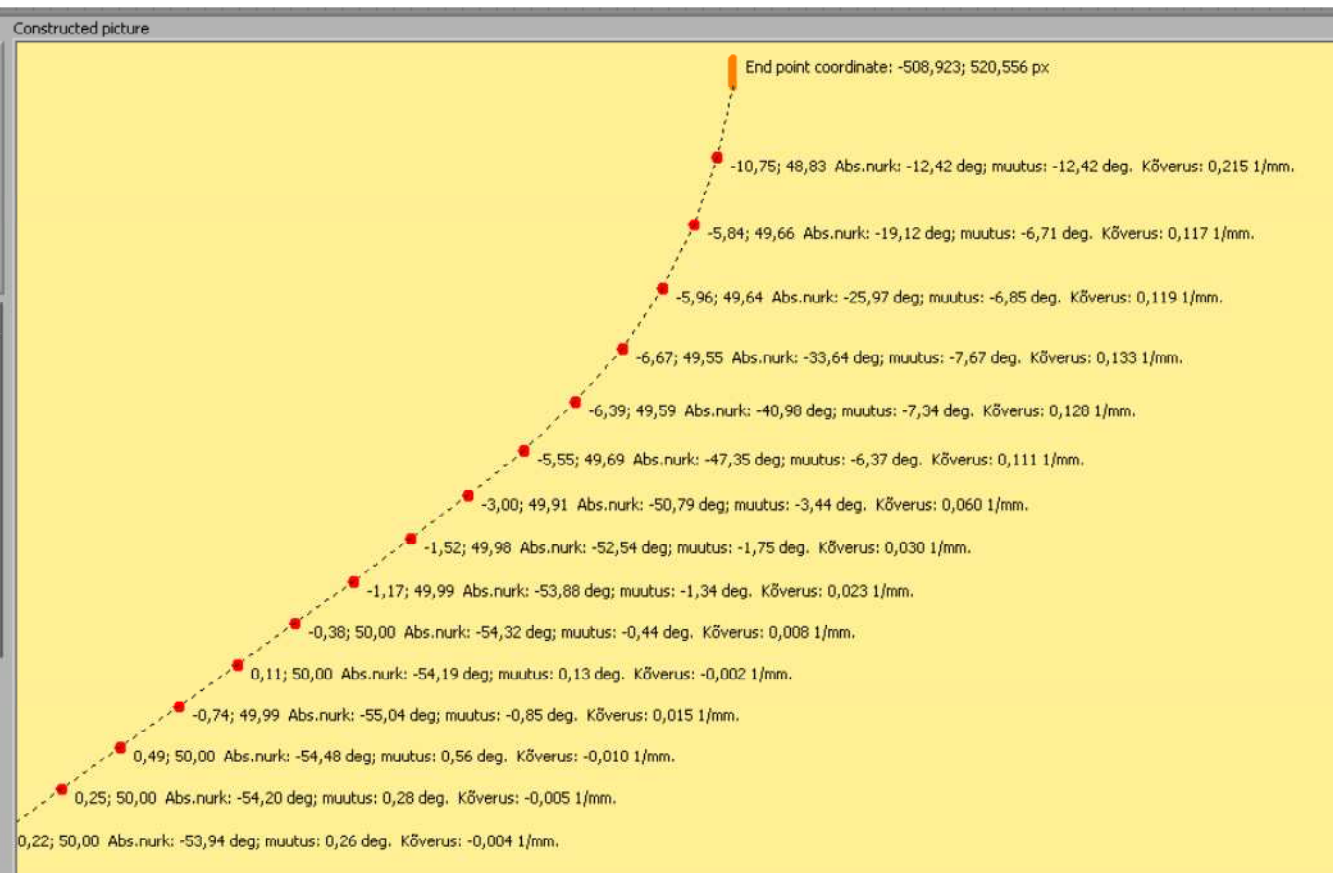
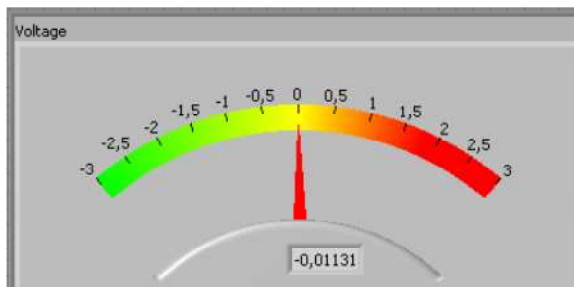




- End point coordinate: -3,367; 749,984 px
- 0,07; 50,00 Abs.nurk: -0,08 deg; muutos: -0,08 deg. Kõverus: 0,001 1/mm.
 - 0,24; 50,00 Abs.nurk: -0,36 deg; muutos: -0,28 deg. Kõverus: 0,005 1/mm.
 - 0,48; 50,00 Abs.nurk: 0,19 deg; muutos: 0,55 deg. Kõverus: -0,010 1/mm.
 - 0,44; 50,00 Abs.nurk: -0,31 deg; muutos: -0,50 deg. Kõverus: 0,009 1/mm.
 - 0,02; 50,00 Abs.nurk: -0,33 deg; muutos: -0,02 deg. Kõverus: 0,000 1/mm.
 - 0,00; 50,00 Abs.nurk: -0,34 deg; muutos: -0,00 deg. Kõverus: 0,000 1/mm.
 - 0,03; 50,00 Abs.nurk: -0,30 deg; muutos: 0,04 deg. Kõverus: -0,001 1/mm.
 - 0,00; 50,00 Abs.nurk: -0,30 deg; muutos: -0,00 deg. Kõverus: 0,000 1/mm.
 - 0,35; 50,00 Abs.nurk: 0,10 deg; muutos: 0,40 deg. Kõverus: -0,007 1/mm.
 - 0,83; 49,99 Abs.nurk: -0,85 deg; muutos: -0,95 deg. Kõverus: 0,017 1/mm.
 - 0,99; 49,99 Abs.nurk: 0,28 deg; muutos: 1,14 deg. Kõverus: -0,020 1/mm.
 - 0,70; 50,00 Abs.nurk: -0,52 deg; muutos: -0,80 deg. Kõverus: 0,014 1/mm.
 - 0,12; 50,00 Abs.nurk: -0,39 deg; muutos: 0,13 deg. Kõverus: -0,002 1/mm.
 - 0,02; 50,00 Abs.nurk: -0,37 deg; muutos: 0,02 deg. Kõverus: -0,000 1/mm.
 - 0,07; 50,00 Abs.nurk: -0,29 deg; muutos: 0,08 deg. Kõverus: -0,001 1/mm.





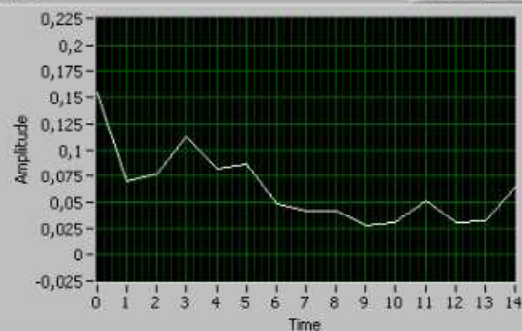


Voltage

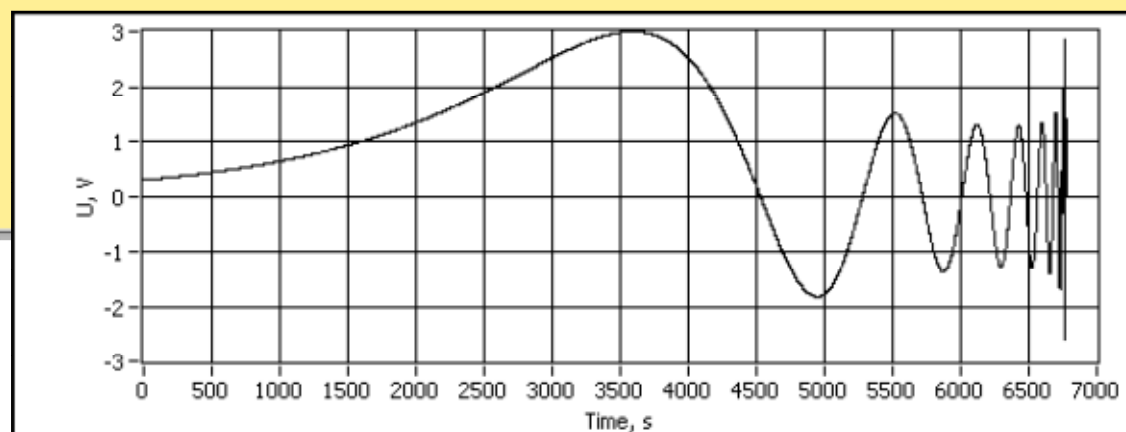
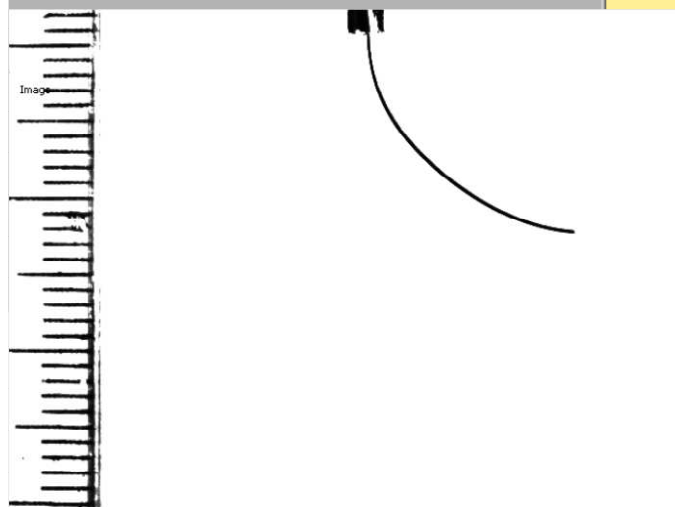


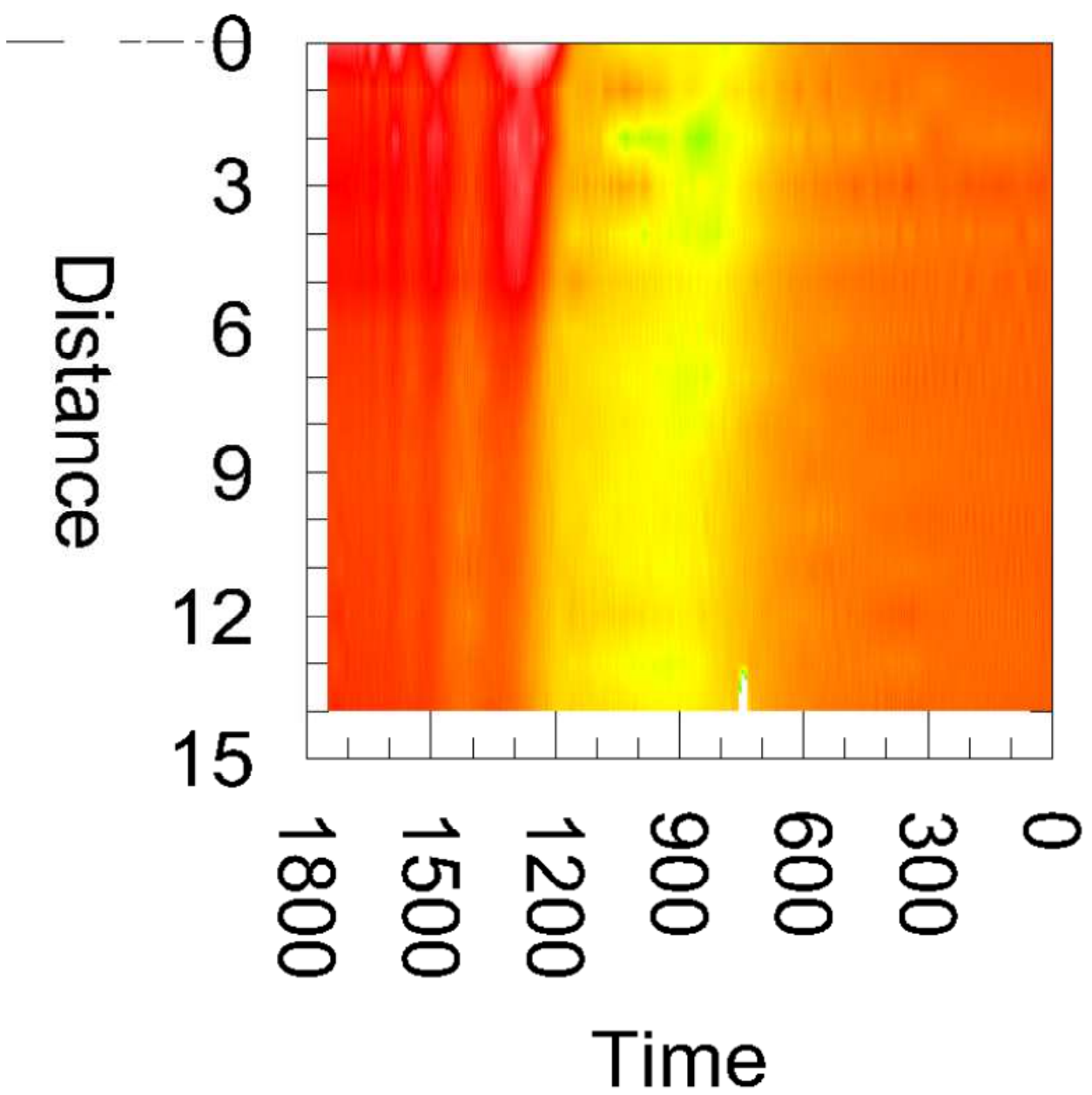
Curvature

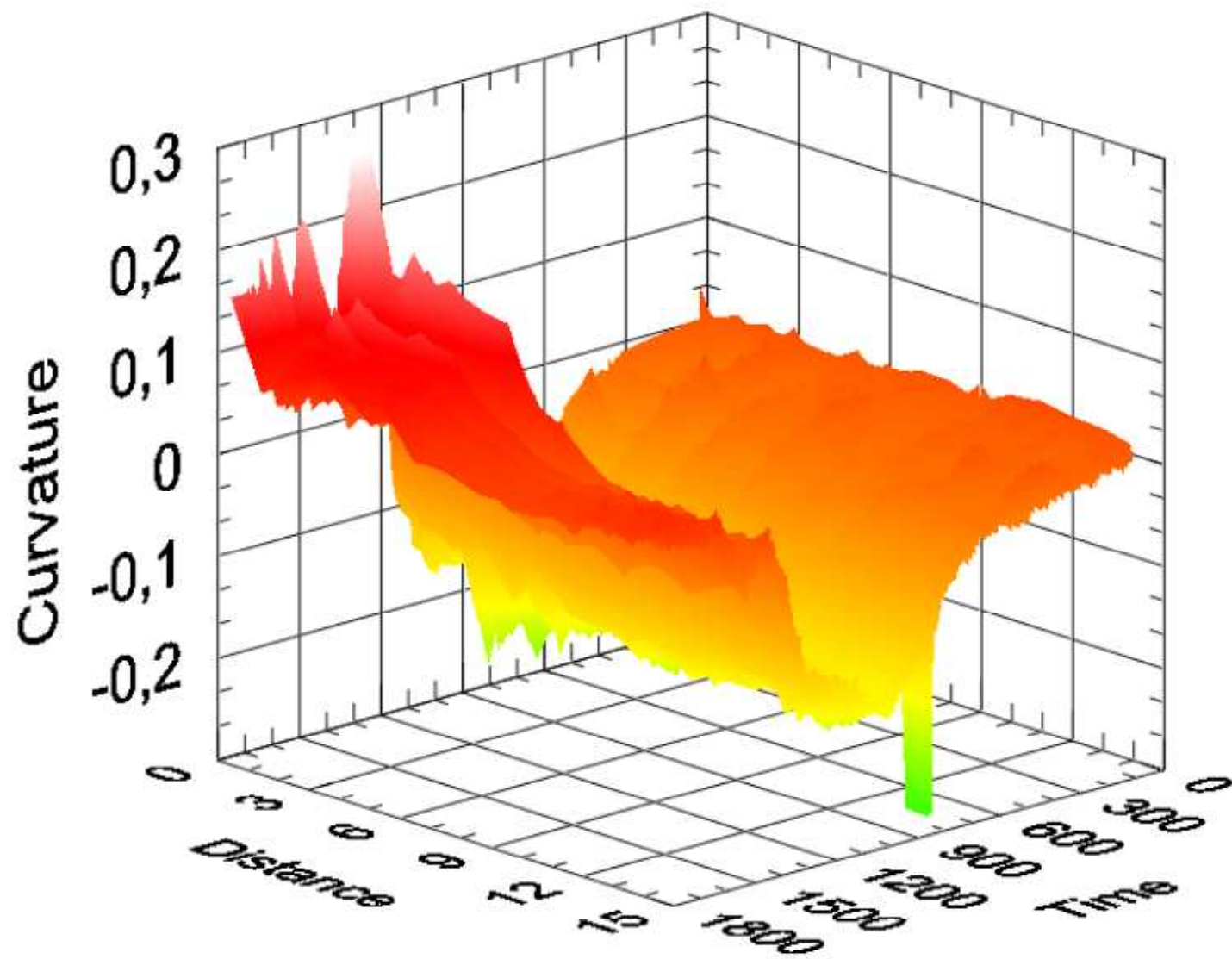
Plot 0

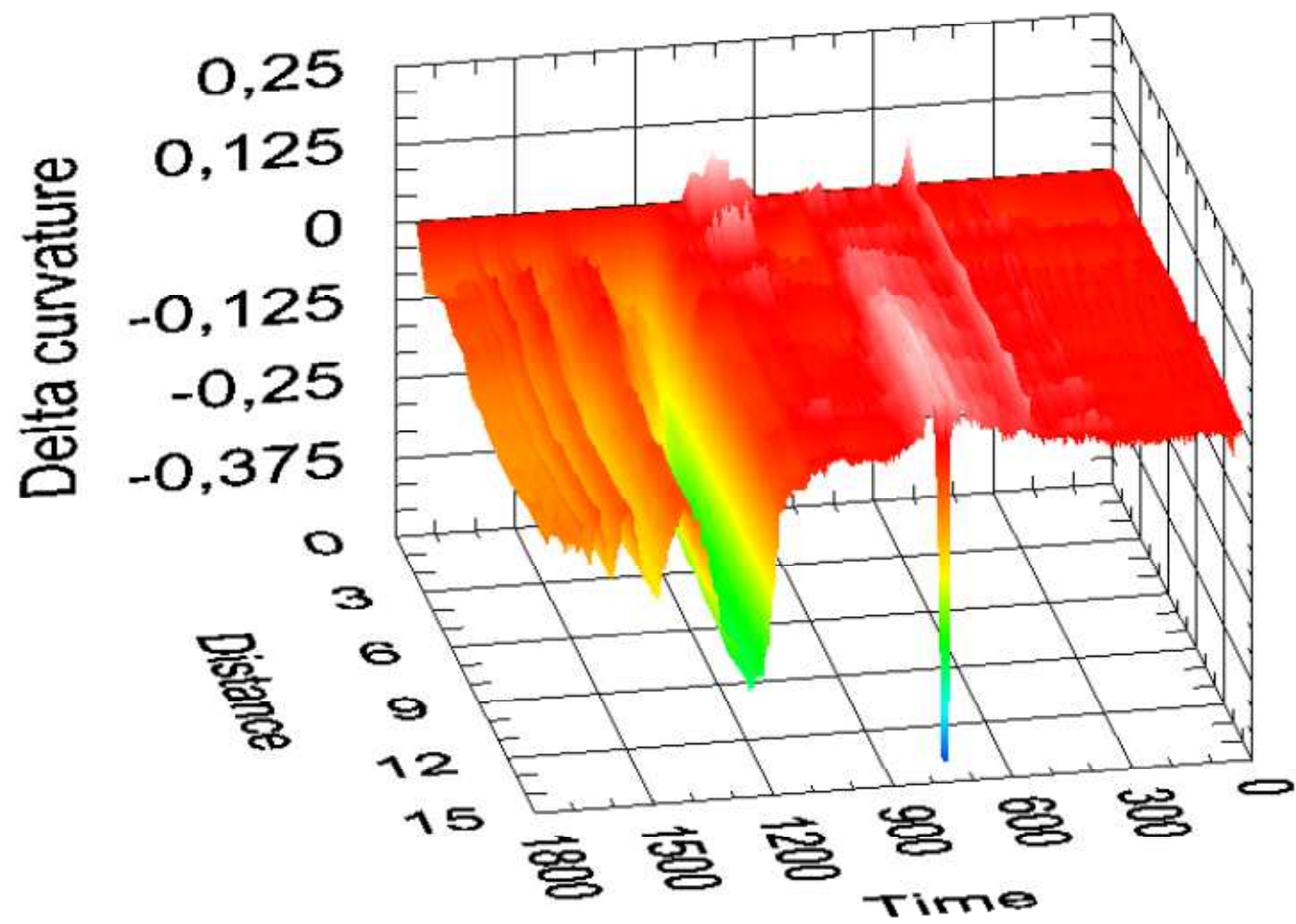


Constructed picture

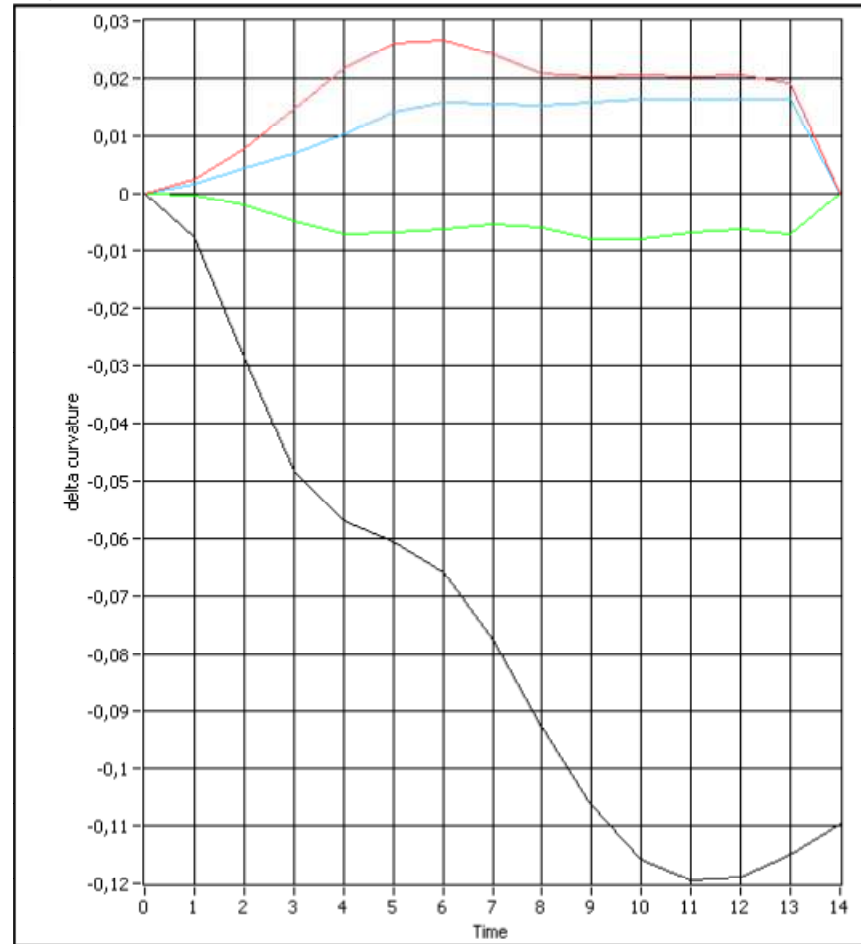




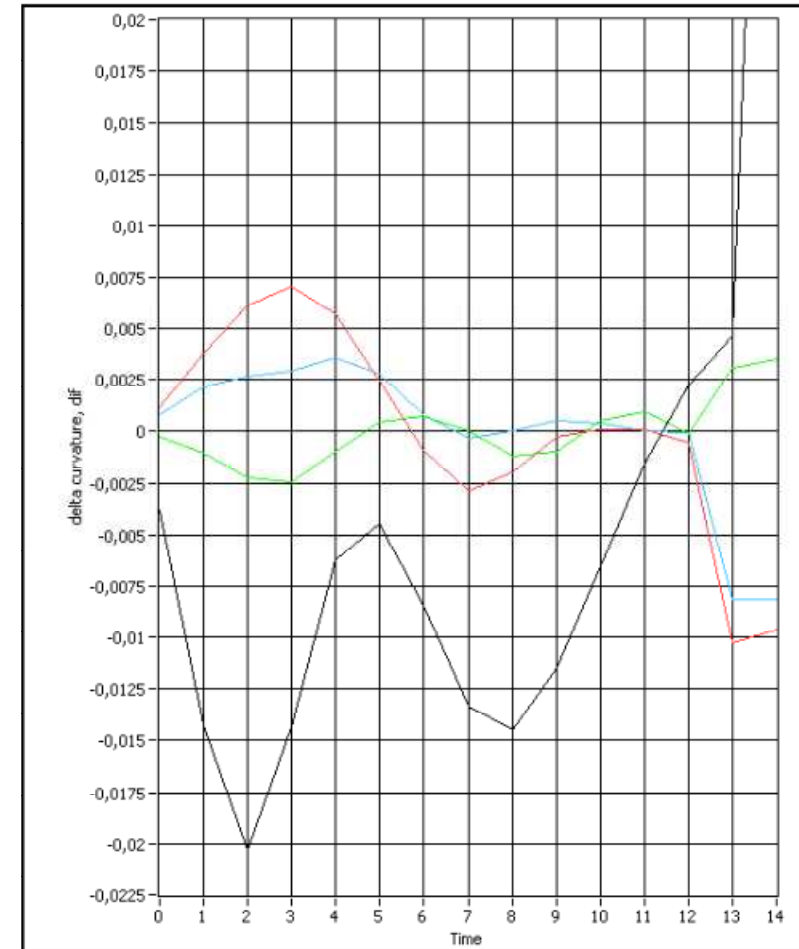




ampl



dif

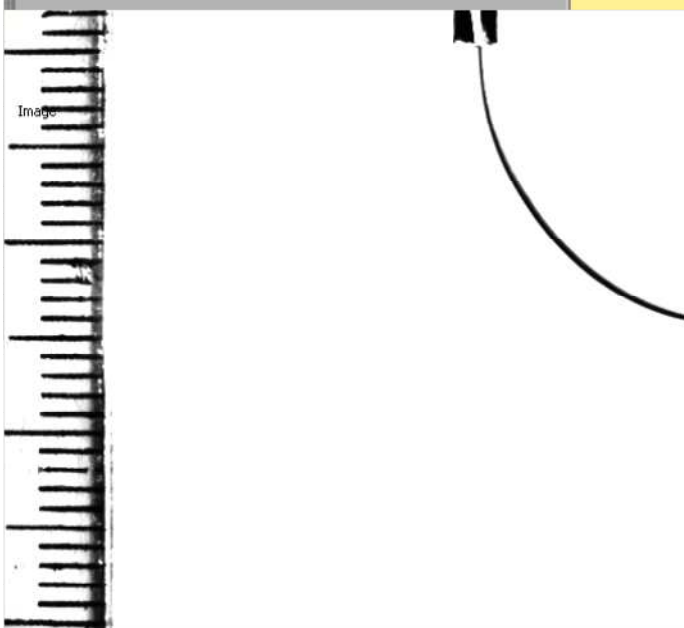
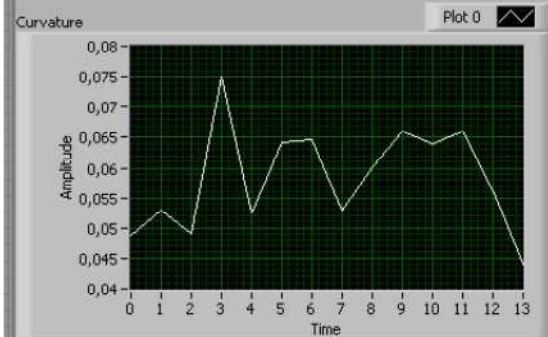
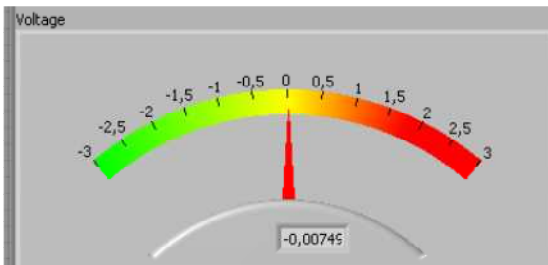




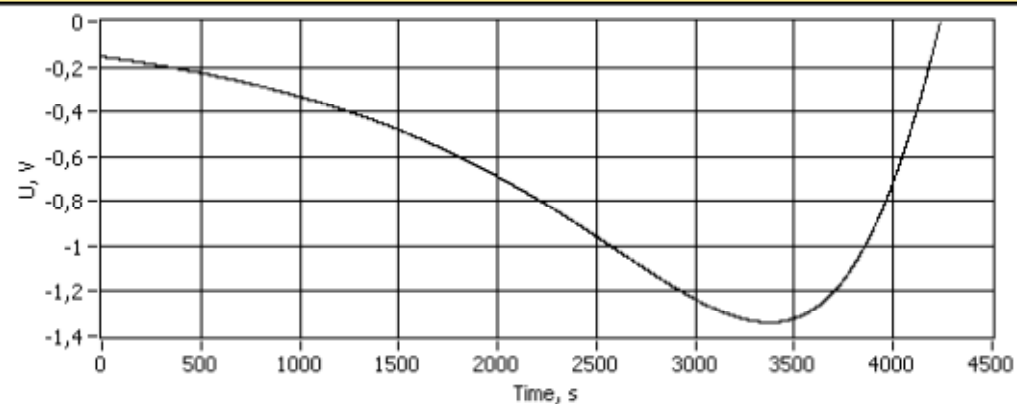
Kiirendatud 100x



Aeglustatud 12,5x



Constructed picture



Mõtted

- Mahtuvuse ja pinnatakistuse SUHE (pikkusühiku kohta) on oluline
 - Geomeetria on oluline
- Väikese relaksatsiooniga lihas
 - Saab kasutada lihtsat RC mudelit
- Jäik lihas eelistatuim

EDASI

- Keerulisemad ekv.skeemid
- FEM
- Rohkem eri tüüpi materjale
- Kiiremaks

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