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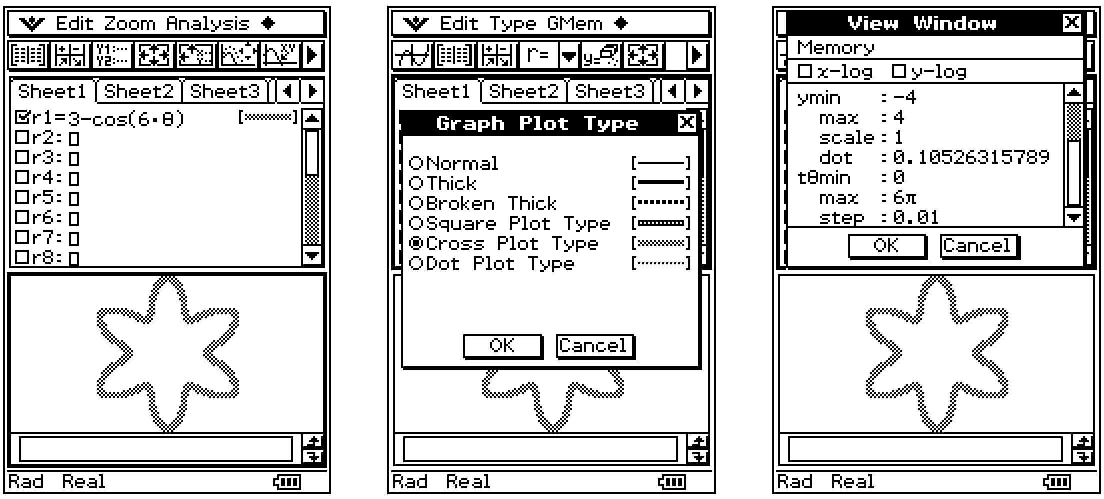
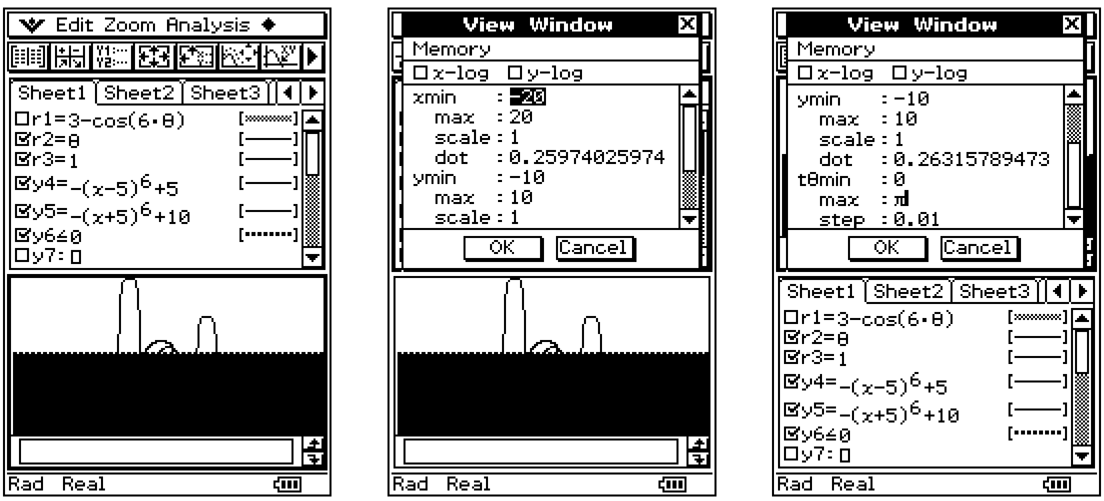
Workshop I (Ciechocinek, Poland, 27th June 2004)
Several aspects of 2D-graphics with the ClassPad300

Let's beginning with some nice graphics (cartesian, polar or parametric):

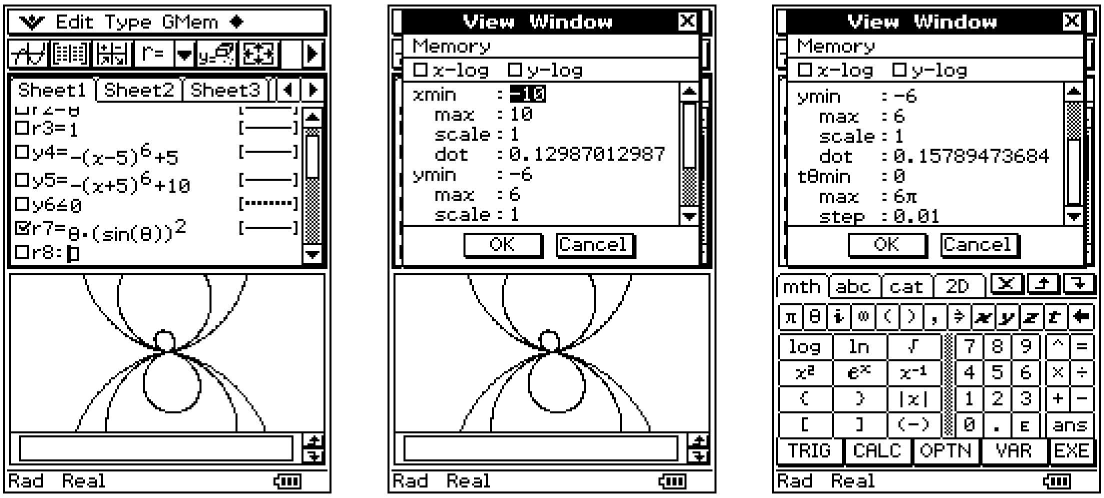
1. a **snowflake** $r1 = r(\theta) = 3 - \cos(6\theta)$, $0 \leq \theta \leq 2\pi$, $-8 \leq x \leq 8$, $-4 \leq y \leq 4$.



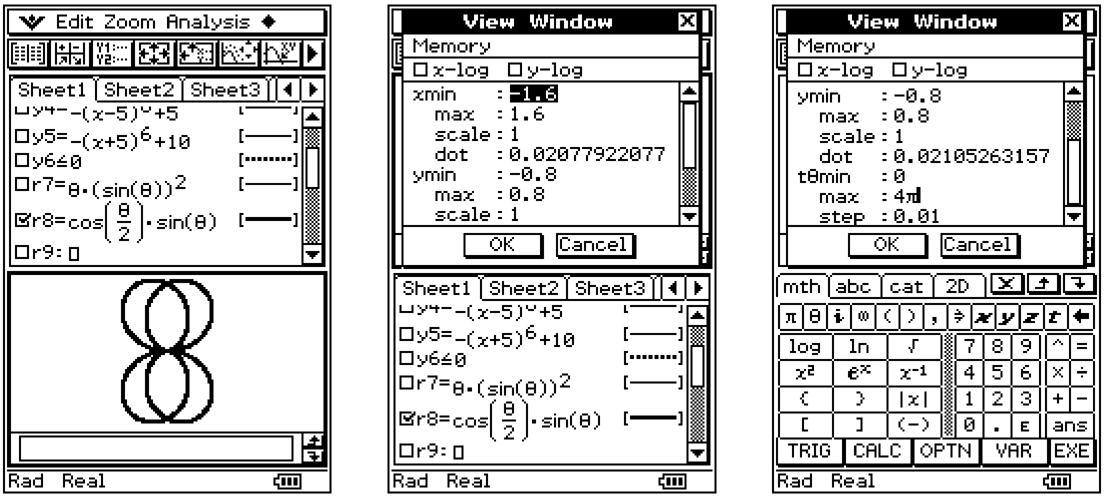
2. a **butterfly swimmer** $r2 = r(\theta) = \theta$, $r3 = r(\theta) = 1$, $0 \leq \theta \leq \pi$, $-20 \leq x \leq 20$, $-10 \leq y \leq 10$, $y4 = y(x) = -(x-5)^6 + 5$, $y5 = y(x) = -(x+5)^6 + 10$, $y6 = y(x) \leq 0$.



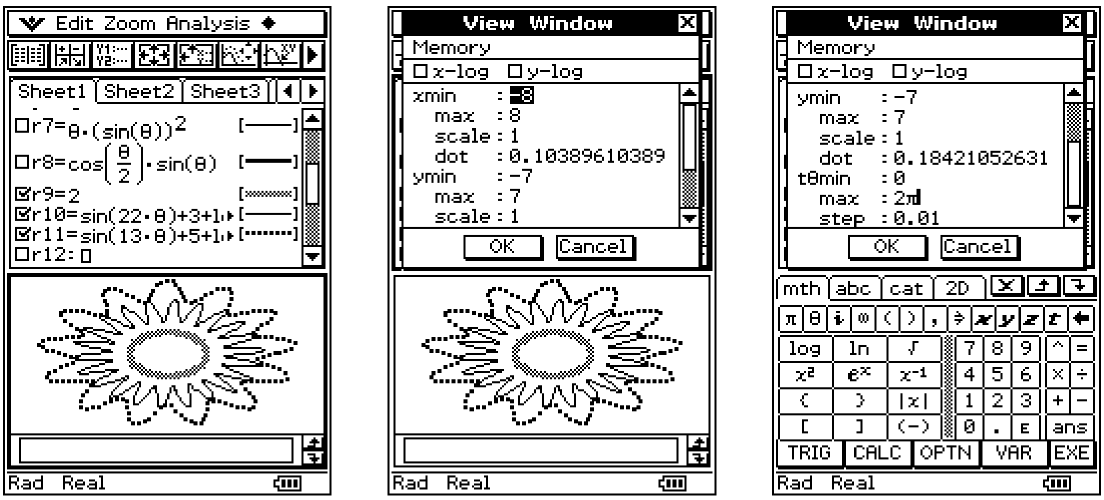
3. a **spider** $r7 = r(\theta) = \theta * (\sin(\theta))^{\wedge}2$, $0 \le \theta \le 6\pi$, $-10 \le x \le 10$, $-6 \le y \le 6$.



4. the **number 8** $r8 = r(\theta) = \cos(\theta/2) * \sin(\theta)$, $0 \le \theta \le 4\pi$, $-1.6 \le x \le 1.6$, $-0.8 \le y \le 0.8$.



5. a **hibiscus flower** $r9 = r(\theta) = 2$, $r10 = r(\theta) = \sin(22\theta)+3+\lg(9)$,
$r11 = r(\theta) = \sin(13\theta)+5+\lg(5)$, $0 \le \theta \le 2\pi$, $-8 \le x \le 8$, $-7 \le y \le 7$.

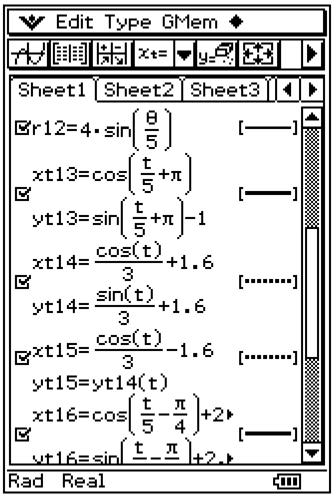


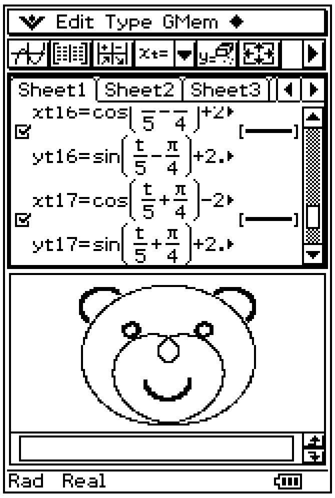
6. a **bear r12 = r(θ) = 4*sin(θ/5), 0 ≤ θ ≤ 5π , -6.8 ≤ x ≤ 6.8 , -3.5 ≤ y ≤ 4.5,**

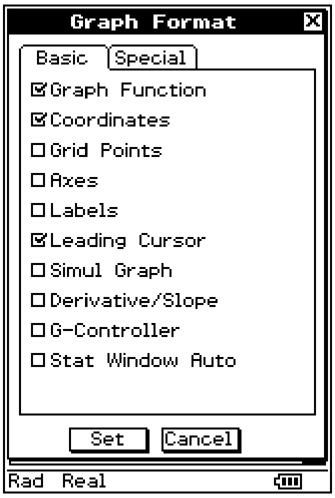
xt13 = x(t) = cos(t/5+π) , yt13 = y(t) = sin(t/5+ π) – 1,

xt14 = x(t) = cos(t)/3 + 1.6 , yt14 = y(t) = sin(t)/3 + 1.6,
xt15 = x(t) = cos(t)/3 - 1.6, yt15 = y(t) = sin(t)/3 + 1.6,

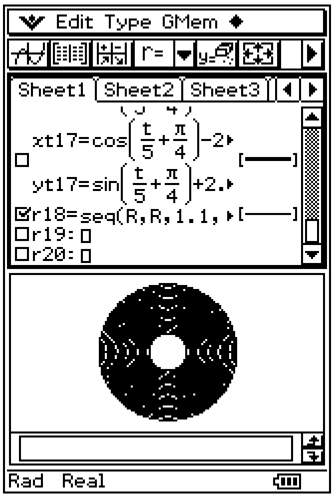
xt16 = x(t) = cos(t/5-π/4) + 2.8 , yt16 = y(t) = sin(t/5-π/4) + 2.8,
xt17 = x(t) = cos(t/5+π/4) - 2.8, yt17 = y(t) = sin(t/5+π/4) + 2.8.

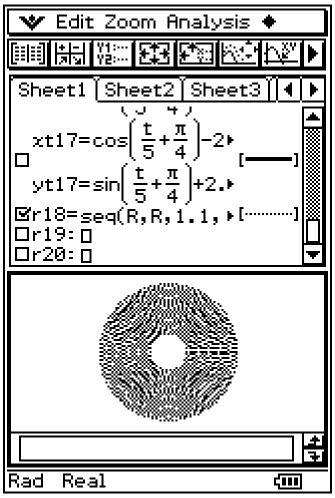


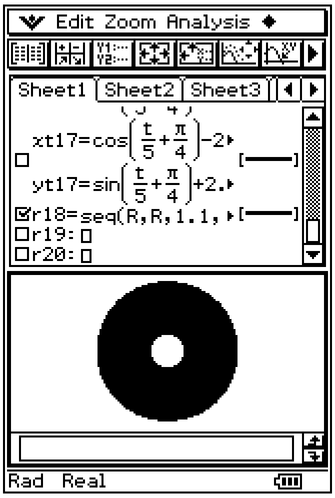




7. a **CD-rom r18 = r(θ) = seq(R, R, 1.1, 4, 0.145), 0 ≤ θ ≤ 2π , -9 ≤ x ≤ 9, -4.5 ≤ y ≤ 4.5.**





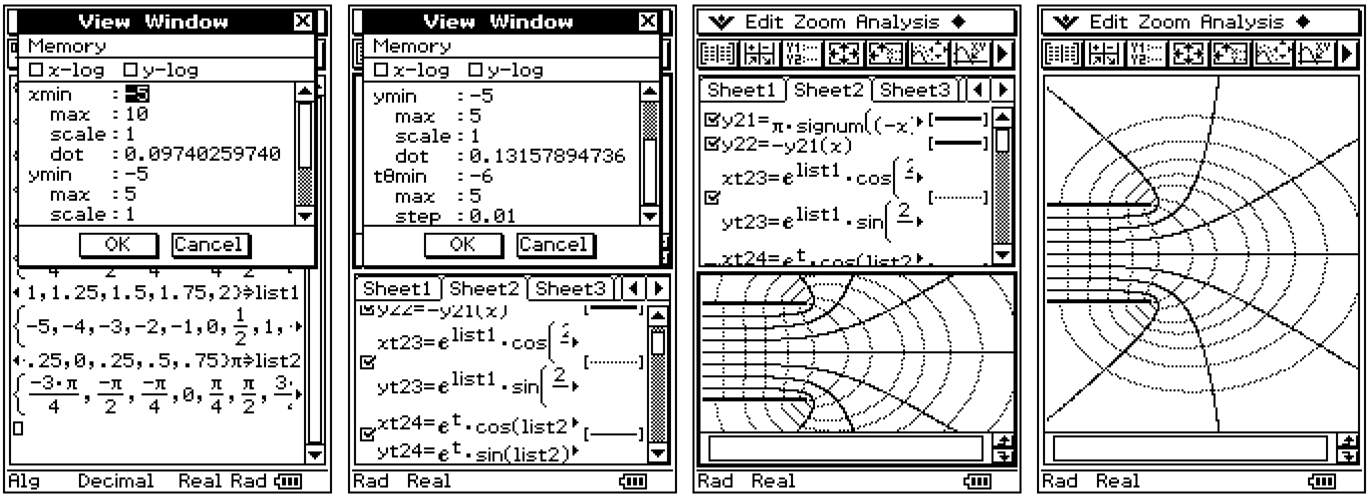


8. a **disk-capacitor List1 = {-5, -4, -3, -2 ,-1, 0, .5, 1, 1.25, 1.5, 1.75, 2} ,**
List2 = {-.75, -.5, -.25, 0, .25, .5, .75}*π , (input in main-menu)

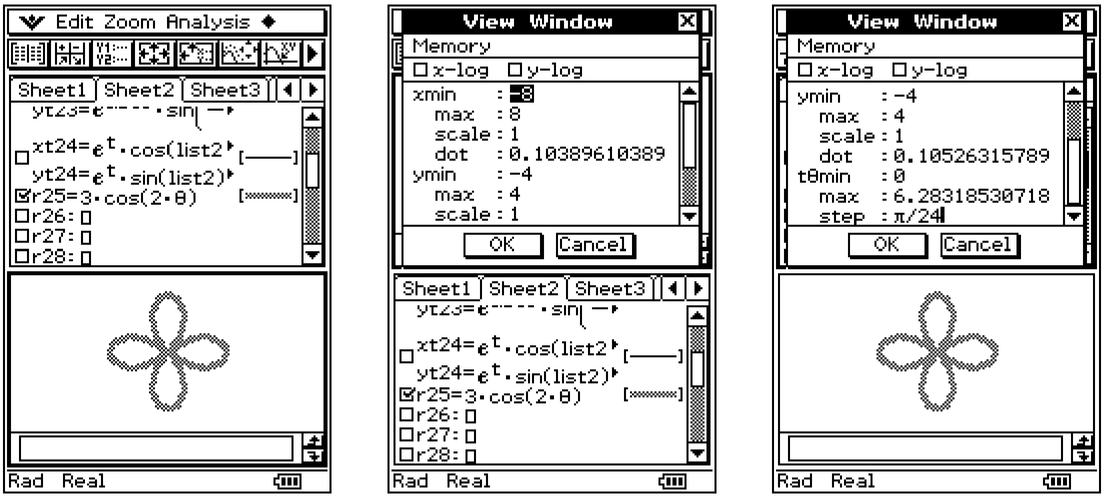
y21= y(x) = π*signum((-x)^.5), y22 = y(x) = -y21(x), (the disk-capacitor)

xt23 = x(t) = e^List1 * cos((2t+1)π / 11) + List1 + 1 , (the potential-lines)
yt23 = y(t) = e^List1 * sin((2t+1)π / 11) + (2t+1)π / 11 ,

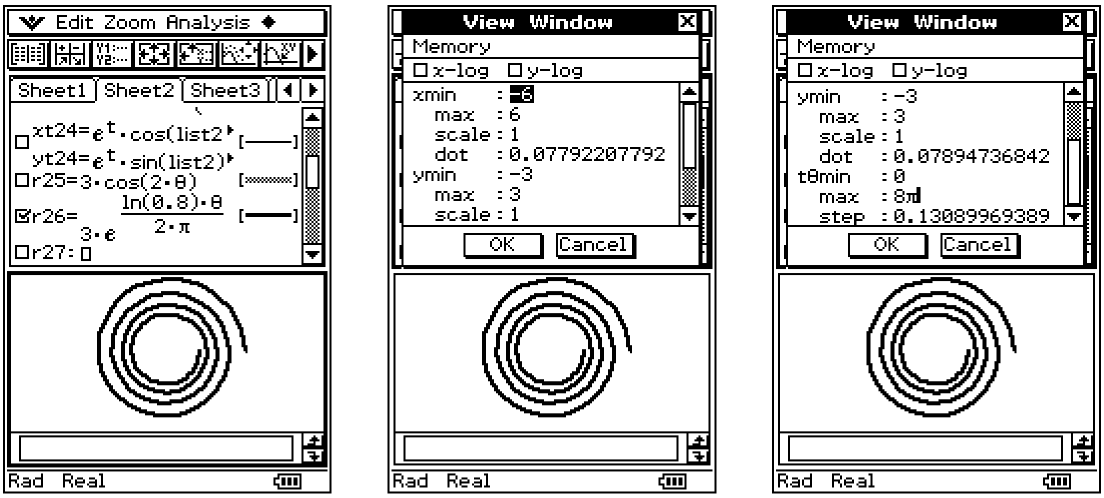
xt24 = x(t) = e^t * cos(List2) + t + 1 , (the field-lines)
yt24 = y(t) = e^t * sin(List2) + List2, -6 ≤ θ,t ≤ 5 , -5 ≤ x ≤ 10, -5 ≤ y ≤ 5 .



9. a **four-leaf clover r25 = r(θ) = 3*cos(2θ), 0 ≤ θ ≤ 2π , -8 ≤ x ≤ 8, -4 ≤ y ≤ 4 .**

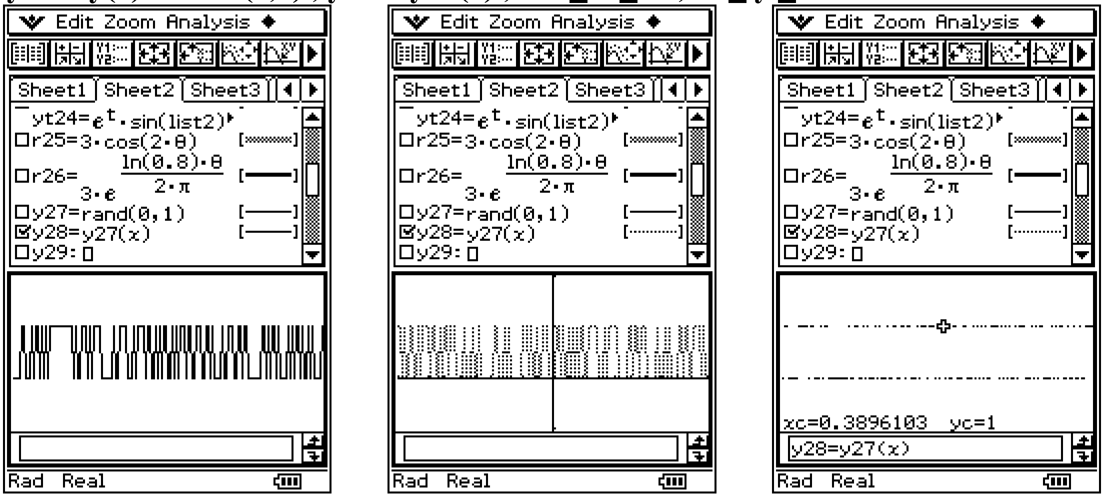


10. an **exponential spiral r26 = r(θ) = 3*e^(ln(0.8)* θ /(2π)), 0 ≤ θ ≤ 8π , -6 ≤ x ≤ 6, -3 ≤ y ≤ 3 .**



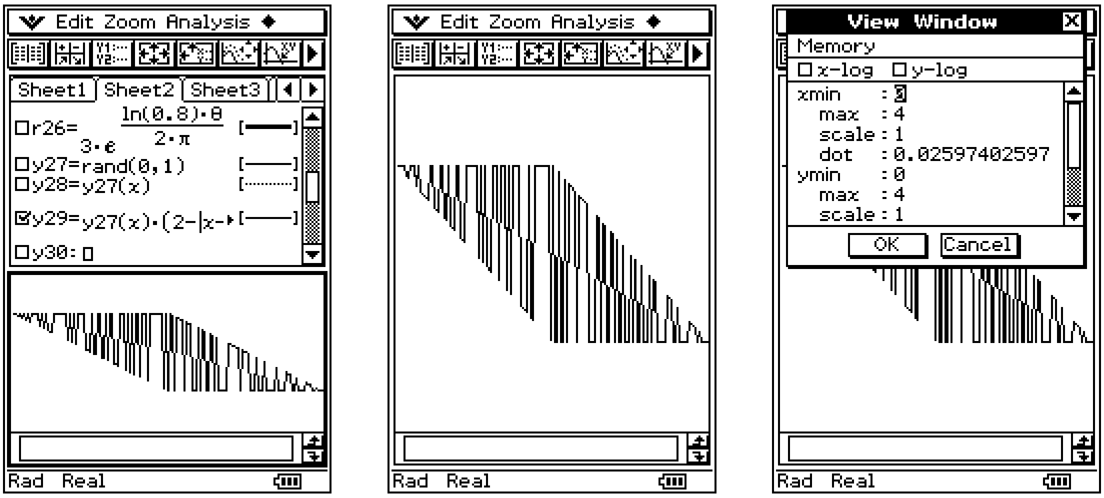
Now consider a random function, using the random generator of ClassPad300:

y27 = y(x) = rand(0,1) , y28 = y27(x) , -10 ≤ x ≤ 10, -1 ≤ y ≤ 2 .



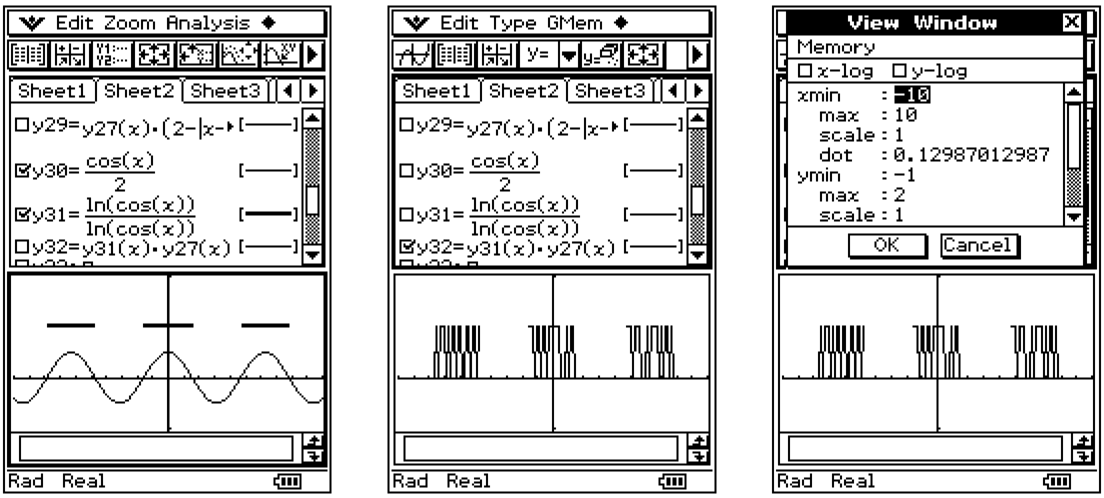
Now consider a random hatching in a parallelogram:

y27 = y(x) = rand(0,1) , y29 = y(x) = y27(x)*(2-|x-2|) + 2 + (|x-2|-x)/2, 0 ≤ x ≤ 4, 0 ≤ y ≤ 4 .



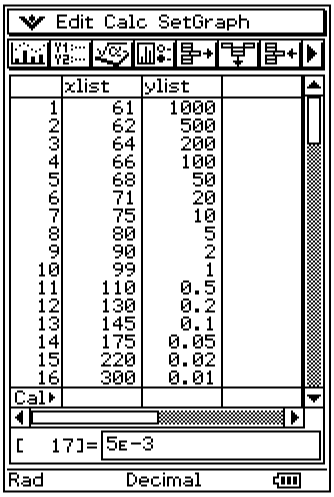
Now consider a periodic random signal with time out (pause):

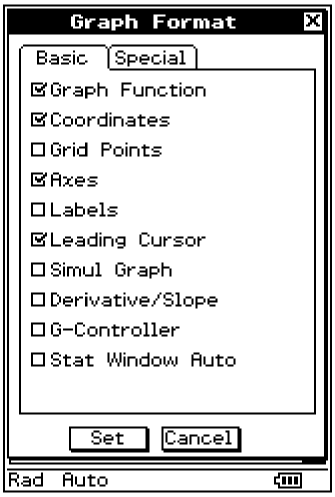
y27 = y(x) = rand(0,1), y30 = y(x) = ln(cos(x))/ln(cos(x)), y31 = y(x) = y27(x)*y30(x) ,
-10 ≤ x ≤ 10, -1 ≤ y ≤ 2 .

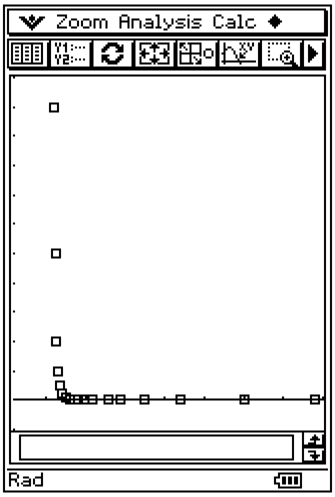


Nonlinear regression in a scatter plot (log-log-scaling of the view-window):

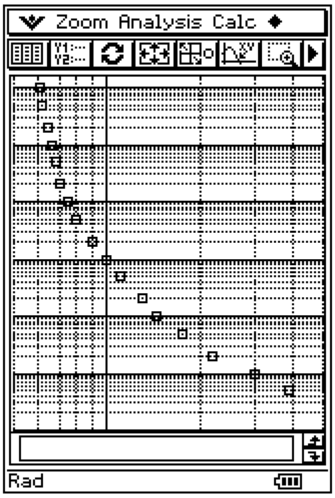
xlist = {61, 62, 64, 66, 68, 71, 75, 80, 90, 99, 110, 130, 145, 175, 220, 300, 390} ,
ylist = {1000, 500, 200, 100, 50, 20, 10, 5, 2, 1, 0.5, 0.2, 0.1, 0.05, 0.02, 0.01, 0.005} .
view-window : 10 ≤ x ≤ 400 , -100 ≤ y ≤ 1100 .

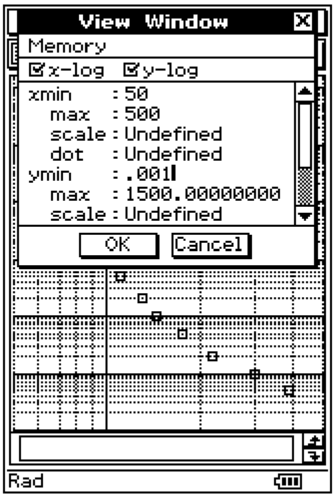


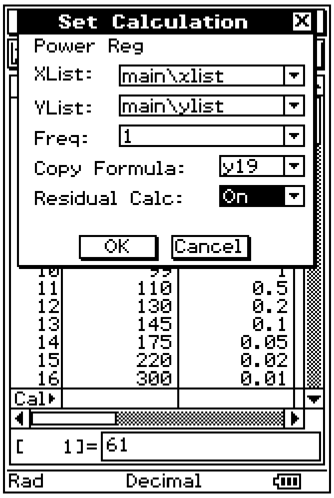


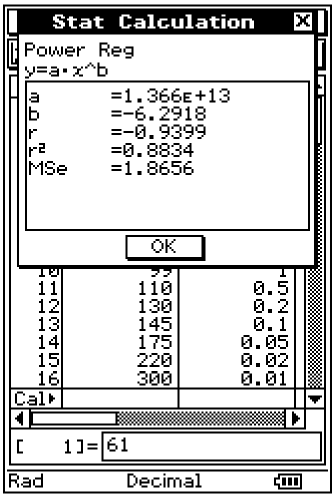


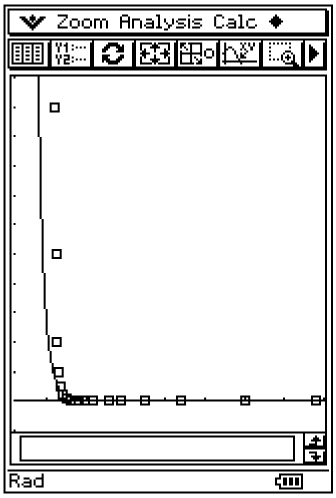
view-window (log-log-scaling): 50 ≤ x ≤ 500 , 0.001 ≤ y ≤ 1500 .



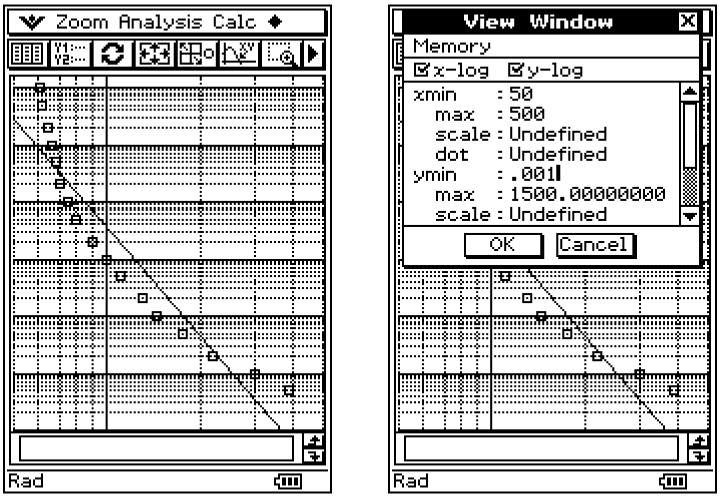








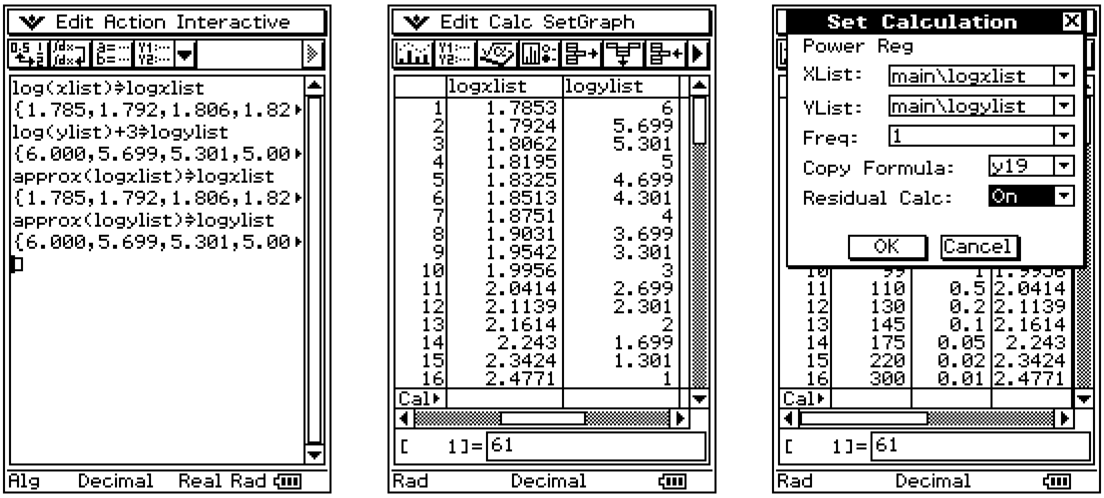
The power-regression in the log-log-scaling shows the bad approximation:

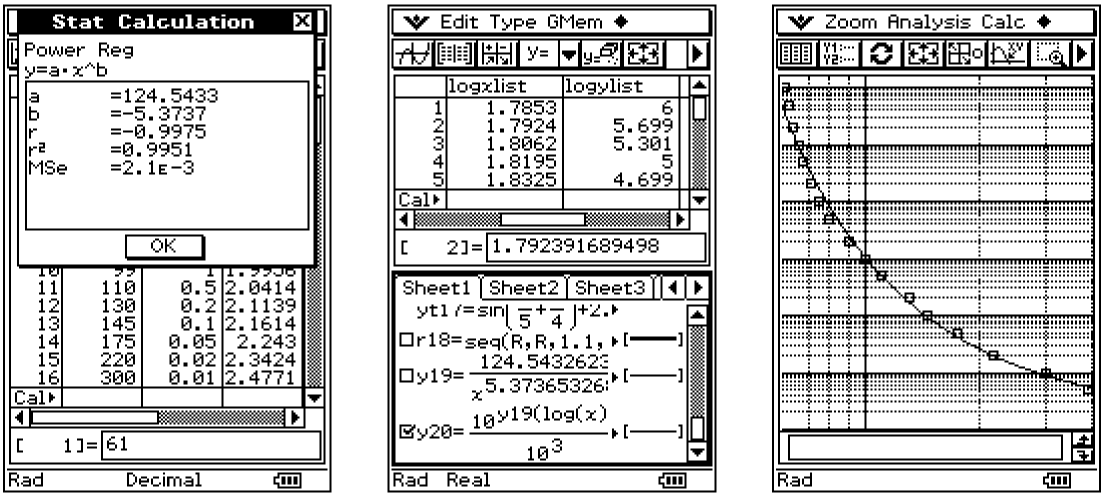


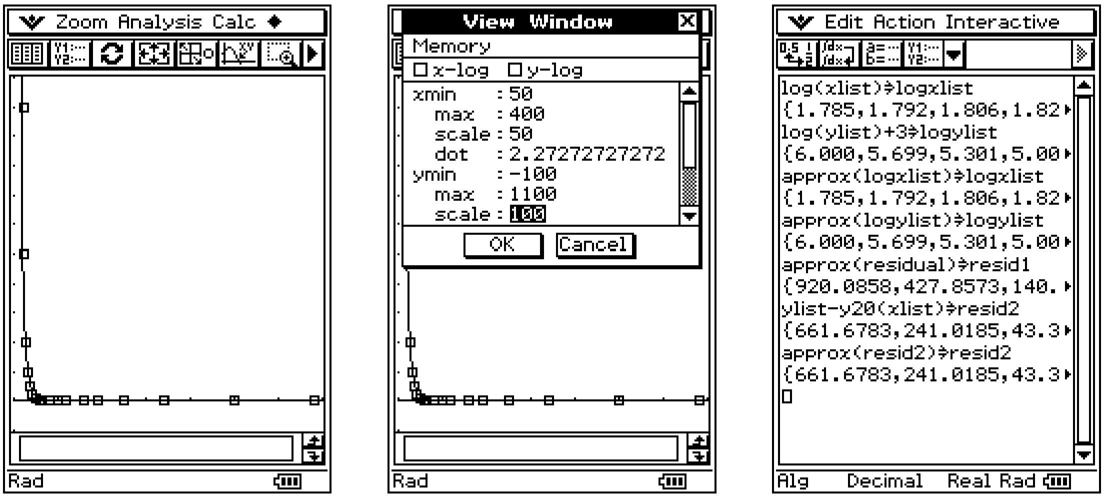
Problem: How to improve the nonlinear regression?
Solution: Transformation of the pairs (xi, yi) into (log(xi), log(yi)+3) , where "+3" to get positive values again.

Power-regression gives y19 = y(x) = a*x^b, i.e. log(y(x)) + 3 = a*log(x)^b , thus

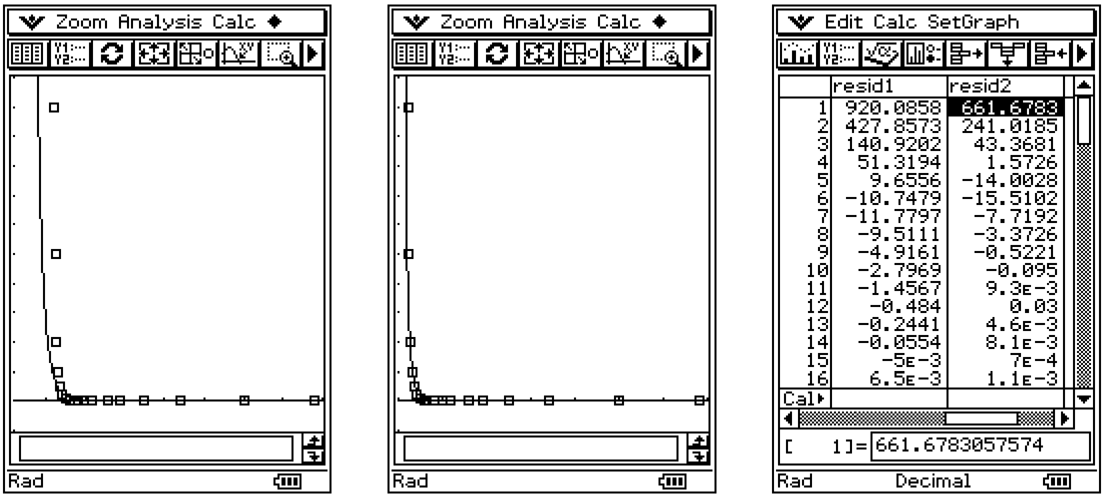
y20 = y(x) = 10^(y19(log(x) – 3) = 10^y19(log(x)) / 10^3 .

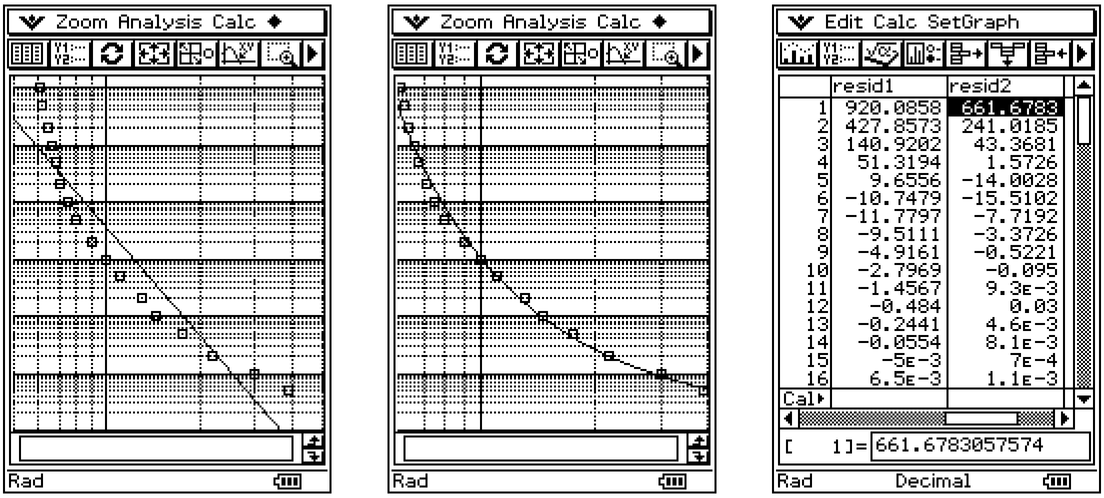






Summary: the scatter-plot with nonlinear regression:





left: the simple power-regression **y(x) = a * x^b**

right: the power regression with log-log-data: **log(y(x)) + 3 = A * (log(x))^B**

and back-transformation: **y(x) = 10^(A * (log(x))^B – 3)**

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