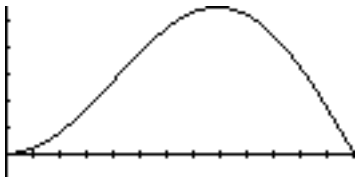
The True harmonically distorted SINe function

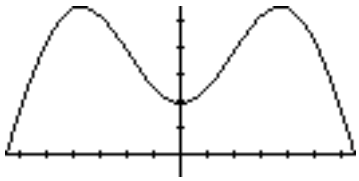
An appealing HP48G Graphics demo **Ph.J.Roussel**

1. Basic function used: cosine function with third harmonic distortion

Consider the Function plots of 'COS(X)-COS(3*X)' in the interval $[0,\frac{\pi}{2}]$

and 'COS(Y)-a3y*COS(3*Y)' with 'a3y=.6' in the interval $[\frac{-\pi}{2},\frac{\pi}{2}]$ (in Rad mode!):





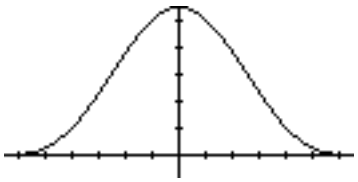
The first function is used in the X direction, the second one in the Y direction:

```
'ZX'   99.5 bytes   Checksum: # F88Ah
« → x 'IFTE(x≥0 AND x≤.5*π,COS(x)-COS(3*x),0)' »
'ZY'   91 bytes   Checksum: # 3EDDh
« → y 'IFTE(2*ABS(y)≤π,COS(y)-a3y*COS(3*y),0)' »
```

The right maximum positions are easily determined using the EXTR command in the interactive PICTURE FCN menu:
(.955316618124,1.53960071784) and (.897444709548,1.164071187) .

The product function 'ZX(X)*ZY(Y)' is used as the basic function for a 3D plot in Wireframe format, with X-LEFT=0, X-RIGHT=1.6, Y-NEAR=-1.5, Y-FAR=1.5 (cf. VPAR values below).

Definition of the variables 'Xe=.955316618124' and 'Ye=.897444709548' allows for translation of additional functions to the top position of the basic function. Consider the Function plot of the harmonically distorted function 'COS(r)+COS(3*r)/3' in the interval $[\frac{-\pi}{2},\frac{\pi}{2}]$:



The function with $\frac{1}{7}$ of the period, confined within the zeros $[\frac{-\pi}{14},\frac{\pi}{14}]$, and translated to each maximum is used in the *radial* direction for putting an extra harmonic distortion on top of the maxima of the basic function 'ZX(X)*ZY(Y)':

```
'ZH'   172.5 bytes   Checksum: # 30D6h
« → x y 'ABS(ABS(y)-Ye+i*(X-Xe))' →NUM → r
'IFTE(2*H*r≤π,aH*(COS(H*r)+COS(3*H*r)/3),0)' →NUM »
```

Note the use of the complex ABS function for the confinement criterion. The 'ABS(y)' gives rise to two symmetric branches in the Y direction at distance Ye from the X axis. As explained, we choose 'H=9'. The amplitude 'aH=.2'.

The complete 3D surface to be defined in 'EQ' is then 'ZX(X)*ZY(Y)+ZH(X,Y)'.

For clarity of the plot, the PICT resolution is enhanced with the command sequence:

#391d #190d PDIM. This triples the normal display resolution.

The following PPAR and VPAR settings are recommended:

```
'VPAR'   115 bytes   Checksum: # 97D3h
{ 0 1.6 -1.5 1.5 0 2.3 -1 1 -1 1 2 -2.5 1.7 41 49 }
'PPAR'   70 bytes   Checksum: # FB35h
{ (-1.6,-.307181334393) (1.6,2.04787556262) X 0 (0,0) WIREFRAME Y }
```

This corresponds with an EYEPT setting of 2 -2.5 1.7, 41 X STEPS, 49 Y STEPS, Z-LOW=0, Z-HIGH=2.3.

The resulting Wireframe plot: illustrates the power of the HP48G: