>

Θέμα :

Σχηματική αναπαράσταση ενός Ανιχνευτή Βαρυτικών Κυμάτων , ως ελατηρίου με δύο ταυτοτικές μάζες στις άκρες του .

$$\begin{bmatrix} \vec{e1} \\ \vec{e2} \\ \vec{e3} \end{bmatrix} = \begin{bmatrix} \cos(a)\,\hat{i} + \cos(b)\,\hat{j} + \cos(c)\,\hat{k} \\ \cos(d)\,\hat{i} + \cos(e)\,\hat{j} + \cos(f)\,\hat{k} \\ \cos(g)\,\hat{i} + \cos(h)\,\hat{j} + \cos(i)\,\hat{k} \end{bmatrix}$$

$$\vec{e1} = \cos(a)\,\hat{i} + \cos(b)\,\hat{j} + \cos(c)\,\hat{k}$$

$$\vec{e2} = \cos(d)\,\hat{i} + \cos(e)\,\hat{j} + \cos(f)\,\hat{k}$$

$$\vec{e3} = \cos(g)\,\hat{i} + \cos(h)\,\hat{j} + \cos(i)\,\hat{k}$$

$$\begin{bmatrix} \hat{i} \\ \hat{j} \\ \hat{k} \end{bmatrix} = \begin{bmatrix} \cos(a)\,\vec{e1} + \cos(d)\,\vec{e2} + \cos(g)\,\vec{e3} \\ \cos(b)\,\vec{e1} + \cos(e)\,\vec{e2} + \cos(h)\,\vec{e3} \\ \cos(c)\,\vec{e1} + \cos(f)\,\vec{e2} + \cos(i)\,\vec{e3} \end{bmatrix}$$

$$\hat{i} = \cos(a)\,\vec{e1} + \cos(d)\,\vec{e2} + \cos(g)\,\vec{e3}$$

$$\hat{j} = \cos(b)\,\vec{e1} + \cos(e)\,\vec{e2} + \cos(h)\,\vec{e3}$$

$$\hat{k} = \cos(c)\,\vec{e1} + \cos(f)\,\vec{e2} + \cos(i)\,\vec{e3}$$

ΜΕΤΑΣΧΗΜΑΤΙΣΜΟΣ ΣΥΣΤΗΜΑΤΩΝ

$$A_x = A_{e1}\cos(a) + A_{e2}\cos(d) + A_{e3}\cos(g)$$

$$A_y = A_{e1}\,coa(b) + A_{e2}\cos(e) + A_{e3}\cos(h)$$

$$A_z = A_{e1}\cos(c) + A_{e2}\cos(f) + A_{e3}\cos(i)$$

Να χαράξουμε Ελικοειδή Καμπύλη (Κυκλική ή Ελλειπτική)
της οποίας τα δύο (2) άκρα A1 , B1 να περνούν από δύο (2) σημεία A , B αντίστοιχα στο χώρο .

ΓΙΑ ΑΛΛΑΓΗ ΔΙΕΥΘΥΝΣΗΣ ΤΗΣ ΔΙΕΓΕΡΣΗΣ , ΑΛΛΑΖΟΥΜΕ ΤΟ : $1 - h\cdot\sin(\Theta)$ ΣΕ : $1 + h\cdot\sin(\Theta)$

>

> *with*(*Physics*[*Vectors*])

[&x, `+`, `.`, *ChangeBasis*, *ChangeCoordinates*, *Component*, *Curl*, *DirectionalDiff*, *Divergence*, *Gradient*, *Identify*, *Laplacian*, ∇, *Norm*, *Setup*, *diff*] **(1)**

> *Setup*(*mathematicalnotation* = *true*)

$$[mathematicalnotation = true] \quad (2)$$

> with(plots) :

>

> $a := 4$

$$a := 4 \quad (3)$$

> $b := 2$

$$b := 2 \quad (4)$$

>

Αριθμός Ελικώσεων n

> $n := 5$

$$n := 5 \quad (5)$$

Πλάτος Ταλάντωσης h

> $h := 0.5$

$$h := 0.5 \quad (6)$$

> $xA := -2$

$$xA := -2 \quad (7)$$

> $yA := 2$

$$yA := 2 \quad (8)$$

> $zA := 1$

$$zA := 1 \quad (9)$$

> $xB := 1$

$$xB := 1 \quad (10)$$

> $yB := 4$

$$yB := 4 \quad (11)$$

> $zB := 7$

$$zB := 7 \quad (12)$$

> $xK := \frac{(xA + xB)}{2}$

$$xK := -\frac{1}{2} \quad (13)$$

> $yK := \frac{(yA + yB)}{2}$

$$yK := 3 \quad (14)$$

> $zK := \frac{(zA + zB)}{2}$

$$zK := 4 \quad (15)$$

> $K := [xK, yK, zK]$

$$K := \left[-\frac{1}{2}, 3, 4\right] \quad (16)$$

> $MHKOSAK := \sqrt{(A[1] - K[1])^2 + (A[2] - K[2])^2 + (A[3] - K[3])^2}$

$$MHKOSAK := \frac{7}{2} \quad (17)$$

>

>

> $A := [xA, yA, zA]$

$$A := [-2, 2, 1] \qquad (18)$$

> $B := [xB, yB, zB]$

$$B := [1, 4, 7] \qquad (19)$$

> $MHKOSAB := \sqrt{(A[1]-B[1])^2 + (A[2]-B[2])^2 + (A[3]-B[3])^2}$

$$MHKOSAB := 7 \qquad (20)$$

> $BHMA := \frac{MHKOSAB}{n}$

$$BHMA := \frac{7}{5} \qquad (21)$$

> $AB := spacecurve([A[1] + \lambda\cdot(B[1]-A[1]), A[2] + \lambda\cdot(B[2]-A[2]), A[3] + \lambda\cdot(B[3] - A[3])], \lambda = 0..1)$:

> $rA\_ := A[1]\cdot\_i + A[2]\cdot\_j + A[3]\cdot\_k$

$$\overrightarrow{rA} := -2\,\hat{i} + 2\,\hat{j} + \hat{k} \qquad (22)$$

> $rB\_ := B[1]\cdot\_i + B[2]\cdot\_j + B[3]\cdot\_k$

$$\overrightarrow{rB} := \hat{i} + 4\,\hat{j} + 7\,\hat{k} \qquad (23)$$

>

ΑΡΧΗ ΤΟΥ $[\overrightarrow{e1}, \overrightarrow{e2}, \overrightarrow{e3}]$ ΤΟ ΣΗΜΕΙΟ Α , $\overrightarrow{e3} = \frac{\overrightarrow{AB}}{|\overrightarrow{AB}|}$

$$HELIX := \left[-a + a\cdot\cos(\phi), + b\cdot\sin(\phi), \frac{BHMA\cdot\phi}{2\cdot Pi}\right]$$

>

> $e3\_ := \frac{(rB\_ - rA\_)}{Norm(rB\_ - rA\_)}$

$$\overrightarrow{e3} := \frac{(3\,\hat{i} + 2\,\hat{j} + 6\,\hat{k})\sqrt{49}}{49} \qquad (24)$$

>

> $Norm(e3\_)$

$$1 \qquad (25)$$

> $C := [xC, yC, zC]$

$$C := [xC, yC, zC] \qquad (26)$$

> $rC\_ := C[1]\cdot\_i + C[2]\cdot\_j + C[3]\cdot\_k$

$$\overrightarrow{rC} := xC\,\hat{i} + yC\,\hat{j} + zC\,\hat{k} \qquad (27)$$

> $simplify((rC\_ - rA\_).e3\_ = 0)$

$$\frac{3\,xC}{7} - \frac{4}{7} + \frac{2\,yC}{7} + \frac{6\,zC}{7} = 0 \qquad (28)$$

> $numer(lhs(\mathbf{(28)})) = 0$

$$3\,xC - 4 + 2\,yC + 6\,zC = 0 \qquad (29)$$

>

SOS : ΕΠΑΛΗΘΕΥΕΤΑΙ και γιά : [xC=--4 , yC=2 , zC=2]

>

> $rC1\_ := -4\cdot\_i + 2\cdot\_j + 2\cdot\_k$

$$\overrightarrow{rC1} := -4\,\hat{i} + 2\,\hat{j} + 2\,\hat{k} \quad (30)$$

> $e1\_ := \dfrac{(rC1\_ - rA\_)}{Norm(rC1\_ - rA\_)}$

$$\overrightarrow{e1} := \frac{(-2\,\hat{i} + \hat{k})\sqrt{5}}{5} \quad (31)$$

>

> $Norm(e1\_)$

$$1 \quad (32)$$

> $\mathbf{e2\_ := e3\_ \times e1\_}$

$$\overrightarrow{e2} := \frac{2\sqrt{49}\sqrt{5}\,\hat{i}}{245} - \frac{3\sqrt{49}\sqrt{5}\,\hat{j}}{49} + \frac{4\sqrt{49}\sqrt{5}\,\hat{k}}{245} \quad (33)$$

> $Norm(e2\_)$

$$1 \quad (34)$$

>

>

$$HELIX := \left[-a + a\cdot\cos(\phi), + b\cdot\sin(\phi), \frac{BHMA\cdot\phi}{2\cdot Pi}\right]$$

>

ΕΠΙΒΟΛΗ ΔΙΕΓΕΡΣΗΣ SINUS ΣΤΟ ΣΗΜΕΙΟ B στην διεύθυνση του άξονα BA .

>

> $(-a + a\cdot\cos(\phi))\cdot e1\_ + (b\cdot\sin(\phi))\cdot e2\_ + \left(\frac{BHMA}{2\cdot Pi}\cdot\phi\cdot(0.5 - h\cdot\sin(\Theta))\right)\cdot e3\_ + K[1]\cdot\_i + K[2]\cdot\_j + K[3]\cdot\_k$

$$(1.600000000\sqrt{5} - 1.600000000\cos(\phi)\sqrt{5} + 0.01632653061\sin(\phi)\sqrt{49}\sqrt{5} + 0.006820926132\,\phi\sqrt{49} - 0.006820926132\,\phi\sin(\Theta)\sqrt{49} - 0.5000000000)\,\hat{i} + (-0.1224489796\sin(\phi)\sqrt{49}\sqrt{5} + 0.004547284088\,\phi\sqrt{49} - 0.004547284088\,\phi\sin(\Theta)\sqrt{49} + 3.)\,\hat{j} + (-0.8000000000\sqrt{5} + 0.8000000000\cos(\phi)\sqrt{5} + 0.03265306122\sin(\phi)\sqrt{49}\sqrt{5} + 0.01364185226\,\phi\sqrt{49} - 0.01364185226\,\phi\sin(\Theta)\sqrt{49} + 4.)\,\hat{k} \quad (35)$$

>

> $HELIXBK := [Component(\mathbf{(35)}, 1), Component(\mathbf{(35)}, 2), Component(\mathbf{(35)}, 3)]$

$$HELIXBK := [1.600000000\sqrt{5} - 1.600000000\cos(\phi)\sqrt{5} + 0.01632653061\sin(\phi)\sqrt{49}\sqrt{5} + 0.006820926132\,\phi\sqrt{49} \quad (36)$$

$-0.006820926132\,\phi\sin(\Theta)\sqrt{49}-0.5000000000,\ -0.1224489796\sin(\phi)\sqrt{49}\sqrt{5}$
$+0.004547284088\,\phi\sqrt{49}-0.004547284088\,\phi\sin(\Theta)\sqrt{49}+3.,$
$-0.8000000000\sqrt{5}+0.8000000000\cos(\phi)\sqrt{5}+0.03265306122\sin(\phi)\sqrt{49}\sqrt{5}$
$+0.01364185226\,\phi\sqrt{49}-0.01364185226\,\phi\sin(\Theta)\sqrt{49}+4.]$

\>

ΕΠΙΒΟΛΗ ΔΙΕΓΕΡΣΗΣ SINUS ΣΤΟ ΣΗΜΕΙΟ Α στην διεύθυνση του άξονα ΑΒ .

\>

\> $(-a+a\cdot\cos(-\phi))\cdot e1\_+(b\cdot\sin(-\phi))\cdot e2\_+\left(\frac{BHMA}{2\cdot\mathrm{Pi}}\cdot\phi\cdot(-0.5+h\cdot\sin(\Theta))\right)\cdot e3\_+K[1]\cdot\_i+K[2]\cdot\_j+K[3]\cdot\_k$

$$\left(1.600000000\sqrt{5}-1.600000000\cos(\phi)\sqrt{5}-0.01632653061\sin(\phi)\sqrt{49}\sqrt{5}-0.006820926132\,\phi\sqrt{49}+0.006820926132\,\phi\sin(\Theta)\sqrt{49}-0.5000000000\right)\hat{i}+\left(0.1224489796\sin(\phi)\sqrt{49}\sqrt{5}-0.004547284088\,\phi\sqrt{49}+0.004547284088\,\phi\sin(\Theta)\sqrt{49}+3.\right)\hat{j}+\left(-0.8000000000\sqrt{5}+0.8000000000\cos(\phi)\sqrt{5}-0.03265306122\sin(\phi)\sqrt{49}\sqrt{5}-0.01364185226\,\phi\sqrt{49}+0.01364185226\,\phi\sin(\Theta)\sqrt{49}+4.\right)\hat{k} \quad (37)$$

\>

\> $HELIXAK := [Component((37), 1), Component((37), 2), Component((37), 3)]$

$$HELIXAK := [1.600000000\sqrt{5}-1.600000000\cos(\phi)\sqrt{5}-0.01632653061\sin(\phi)\sqrt{49}\sqrt{5}-0.006820926132\,\phi\sqrt{49}+0.006820926132\,\phi\sin(\Theta)\sqrt{49}-0.5000000000,\ 0.1224489796\sin(\phi)\sqrt{49}\sqrt{5}-0.004547284088\,\phi\sqrt{49}+0.004547284088\,\phi\sin(\Theta)\sqrt{49}+3.,\ -0.8000000000\sqrt{5}+0.8000000000\cos(\phi)\sqrt{5}-0.03265306122\sin(\phi)\sqrt{49}\sqrt{5}-0.01364185226\,\phi\sqrt{49}+0.01364185226\,\phi\sin(\Theta)\sqrt{49}+4.] \quad (38)$$

\>

\> $animHELIXBK := animate(spacecurve, [HELIXBK, \phi=0..n\cdot 2\cdot\mathrm{Pi}, color=blue], \Theta=0..2\cdot\mathrm{Pi}, frames=101):$

\> $animHELIXAK := animate(spacecurve, [HELIXAK, \phi=0..n\cdot 2\cdot\mathrm{Pi}, color=blue], \Theta=0..2\cdot\mathrm{Pi}, frames=101):$

\>

ΤΟ ΣΗΜΕΙΟ Α στο [e1,e2,e3]

\> $A1 := [0, 0, MHKOSAB\cdot(0+h\cdot\sin(\Theta))]$

$$A1 := [0, 0, 3.5\sin(\Theta)] \quad (39)$$

\>

ΤΟ ΣΗΜΕΙΟ Β στο [e1,e2,e3]

\> $B1 := [0, 0, MHKOSAB\cdot(1-h\cdot\sin(\Theta))]$

$$B1 := [0, 0, 7 - 3.5\sin(\Theta)] \quad \mathbf{(40)}$$

> $A1B1 := [B1[1] + \lambda\cdot(A1[1] - B1[1]), B1[2] + \lambda\cdot(A1[2] - B1[2]), B1[3] + \lambda\cdot(A1[3] - B1[3])]$

$$A1B1 := [0, 0, 7 - 3.5\sin(\Theta) + \lambda(7.0\sin(\Theta) - 7)] \quad \mathbf{(41)}$$

> $A1B1[1]$

$$0 \quad \mathbf{(42)}$$

> $A1B1[2]$

$$0 \quad \mathbf{(43)}$$

> $A1B1[3]$

$$7 - 3.5\sin(\Theta) + \lambda(7.0\sin(\Theta) - 7) \quad \mathbf{(44)}$$

>

> $linAB := A1B1[1]\cdot e1\_ + A1B1[2]\cdot e2\_ + A1B1[3]\cdot e3\_ + A[1]\cdot\_i + A[2]\cdot\_j + A[3]\cdot\_k$

$$linAB := \left(0.4285714286\sqrt{49} - 0.2142857143\sin(\Theta)\sqrt{49} + 0.4285714287\lambda\sin(\Theta)\sqrt{49} - 0.4285714286\lambda\sqrt{49} - 2.\right)\hat{i} + \left(0.2857142857\sqrt{49} - 0.1428571429\sin(\Theta)\sqrt{49} + 0.2857142858\lambda\sin(\Theta)\sqrt{49} - 0.2857142857\lambda\sqrt{49} + 2.\right)\hat{j} + \left(0.8571428571\sqrt{49} - 0.4285714286\sin(\Theta)\sqrt{49} + 0.8571428574\lambda\sin(\Theta)\sqrt{49} - 0.8571428571\lambda\sqrt{49} + 1.\right)\hat{k} \quad \mathbf{(45)}$$

>

> $ABxyz := [Component(\mathbf{(45)}, 1), Component(\mathbf{(45)}, 2), Component(\mathbf{(45)}, 3)]$

$$ABxyz := [0.4285714286\sqrt{49} - 0.2142857143\sin(\Theta)\sqrt{49} + 0.4285714287\lambda\sin(\Theta)\sqrt{49} - 0.4285714286\lambda\sqrt{49} - 2., 0.2857142857\sqrt{49} - 0.1428571429\sin(\Theta)\sqrt{49} + 0.2857142858\lambda\sin(\Theta)\sqrt{49} - 0.2857142857\lambda\sqrt{49} + 2., 0.8571428571\sqrt{49} - 0.4285714286\sin(\Theta)\sqrt{49} + 0.8571428574\lambda\sin(\Theta)\sqrt{49} - 0.8571428571\lambda\sqrt{49} + 1.] \quad \mathbf{(46)}$$

> $evalf(subs(\{\lambda = 0, \Theta = 0\}, ABxyz))$

$$[1.000000000, 4.000000000, 7.000000000] \quad \mathbf{(47)}$$

> $evalf(subs(\{\lambda = 1, \Theta = 0\}, ABxyz))$

$$[-2., 2., 1.] \quad \mathbf{(48)}$$

>

> $animAB := animate(spacecurve, [ABxyz, \lambda = 0..1, color = gold, thickness = 3, linestyle = 1], \Theta = 0..2\cdot\mathrm{Pi}, frames = 101):$

>

> $AB := spacecurve([A[1] + \lambda\cdot(B[1] - A[1]), A[2] + \lambda\cdot(B[2] - A[2]), A[3] + \lambda\cdot(B[3] - A[3])], \lambda = 0..1, color = red, linestyle = 4):$

> $pA := pointplot3d(A, symbol = solidcircle, symbolsize = 10):$

> $pB := pointplot3d(B, symbol = solidcircle, symbolsize = 10):$

> $pK := pointplot3d(K, symbol = solidcircle, symbolsize = 10):$

>

> $OO := pointplot3d([0, 0, 0], symbol = solidcircle, symbolsize = 10):$

```
> axX := spacecurve([x, 0, 0], x = -5.5 ..5.5, linestyle = 3, thickness = 1, color = blue) :
> axY := spacecurve([0, y, 0], y = -6.5 ..6.5, linestyle = 3, thickness = 1, color = blue) :
> axZ := spacecurve([0, 0, z], z = 0 ..7.5, linestyle = 3, thickness = 2, color = blue) :
> axZ1 := spacecurve([0, 0, z], z = 0 ..5.5, linestyle = 3, thickness = 2, color = blue) :
> ARaxX := arrow([5.5, 0, 0], [0.5, 0, 0], width = 0.1, head_length = 0.3, shape
      = cylindrical_arrow, color = blue) :
> ARaxY := arrow([0, 6.5, 0], [0, 0.5, 0], width = 0.1, head_length = 0.3, shape
      = cylindrical_arrow, color = blue) :
> ARaxZ := arrow([0, 0, 7.5], [0, 0, 0.5], width = 0.1, head_length = 0.3, shape
      = cylindrical_arrow, color = blue) :
> ARaxZ1 := arrow([0, 0, 5.5], [0, 0, 0.5], width = 0.1, head_length = 0.3, shape
      = cylindrical_arrow, color = blue) :
> tX := textplot3d([6.1, 0.0, 0, "x"], color = gold, font = [arial, bold, 14]) :
> tY := textplot3d([0, 7.2, 0, "y"], color = gold, font = [arial, bold, 14]) :
> tZ := textplot3d([0, 0, 8.2, "z"], color = gold, font = [arial, bold, 14]) :
> tZ1 := textplot3d([0, 0, 6.2, "z"], color = gold, font = [arial, bold, 14]) :
>
> tA := textplot3d([A[1] - 0.4, A[2], A[3] - 0.1, "A"], color = blue, font = [arial, bold,
      14]) :
> tB := textplot3d([B[1], B[2] + 0.5, B[3] + 0.3, "B"], color = blue, font = [arial, bold,
      14]) :
>
>
```

ΕΠΙΒΟΛΗ ΔΙΕΓΕΡΣΗΣ ΣΤΟ ΣΗΜΕΙΟ B στην διεύθυνση του άξονα BA .

```
>
> B1[1]·e1_ + B1[2]·e2_ + B1[3]·e3_ + A[1]·_i + A[2]·_j + A[3]·_k
```

$$\left(0.4285714286\sqrt{49} - 0.2142857143\sin(\Theta)\sqrt{49} - 2.\right)\hat{i} + \left(0.2857142857\sqrt{49} - 0.1428571429\sin(\Theta)\sqrt{49} + 2.\right)\hat{j} + \left(0.8571428571\sqrt{49} - 0.4285714286\sin(\Theta)\sqrt{49} + 1.\right)\hat{k} \quad \textbf{(49)}$$

```
> [Component((49), 1), Component((49), 2), Component((49), 3)]
```

$$\left[0.4285714286\sqrt{49} - 0.2142857143\sin(\Theta)\sqrt{49} - 2., 0.2857142857\sqrt{49} - 0.1428571429\sin(\Theta)\sqrt{49} + 2., 0.8571428571\sqrt{49} - 0.4285714286\sin(\Theta)\sqrt{49} + 1.\right] \quad \textbf{(50)}$$

```
> animB := animate(pointplot3d, [(50), symbol = solidcircle, symbolsize = 15, color = green],
      Θ = 0 ..2·Pi, frames = 101, trace = 00) :
>
>
```

ΕΠΙΒΟΛΗ ΔΙΕΓΕΡΣΗΣ ΣΤΟ ΣΗΜΕΙΟ A στην διεύθυνση του άξονα AB .

```
> A1[1]·e1_ + A1[2]·e2_ + A1[3]·e3_ + A[1]·_i + A[2]·_j + A[3]·_k
```

$$\left(0.2142857143\sin(\Theta)\sqrt{49} - 2.\right)\hat{i} + \left(0.1428571429\sin(\Theta)\sqrt{49} + 2.\right)\hat{j} + \left(0.4285714286\sin(\Theta)\sqrt{49} + 1.\right)\hat{k} \quad \textbf{(51)}$$

```
> [Component((51), 1), Component((51), 2), Component((51), 3)]
```

(52)

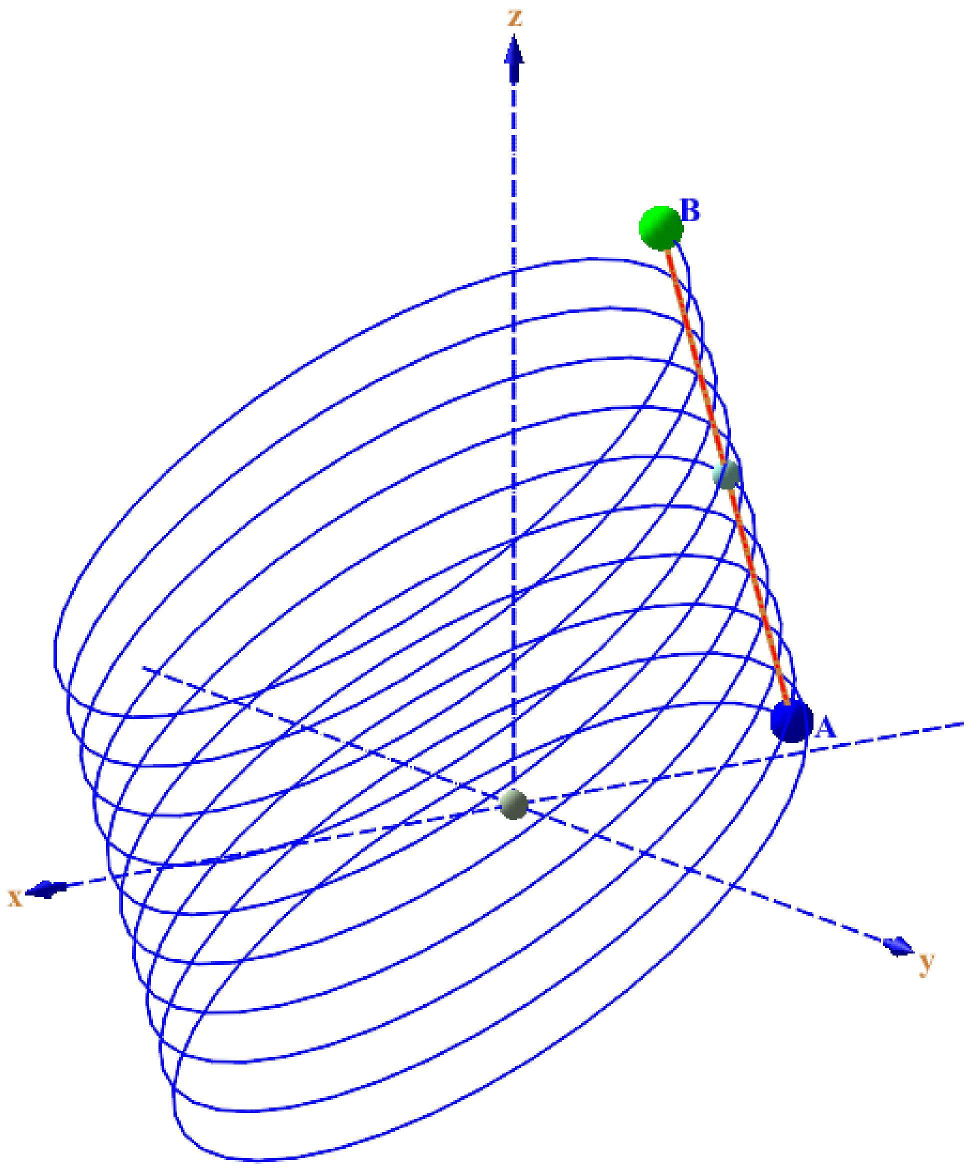
$$[0.2142857143 \sin(\Theta)\sqrt{49} - 2., 0.1428571429 \sin(\Theta)\sqrt{49} + 2., 0.4285714286 \sin(\Theta)\sqrt{49} + 1.] \quad \textbf{(52)}$$

> *animA* := *animate*(*pointplot3d*, [**(52)**, *symbol* = *solidcircle*, *symbolsize* = 15, *color* = *blue*], Θ = 0 ..2·Pi, *frames* = 101, *trace* = 00) :

>

> *display*(*animHELIXBK*, *animHELIXAK*, *animA*, *animB*, *animAB*, *OO*, *axX*, *axY*, *axZ*, *ARaxX*, *ARaxY*, *ARaxZ*, *tX*, *tY*, *tZ*, *pA*, *pB*, *pK*, *AB*, *tA*, *tB*, *axes* = *none*, *scaling* = *constrained*, *title* = "ANIMATION\nΣΧΗΜΑΤΙΚΗ ΑΝΑΠΑΡΑΣΤΑΣΗ ΑΝΙΧΝΕΥΤΗ ΒΑΡΥΤΙΚΩΝ ΚΥΜΑΤΩΝ\nΣΑΒΒΑΣ Π. ΓΑΒΡΙΗΛΙΔΗΣ", *titlefont* = [*arial*, *bold*, 14], *orientation* = [55, 75, 0]) :

ANIMATION
ΣΧΗΜΑΤΙΚΗ ΑΝΑΠΑΡΑΣΤΑΣΗ ΑΝΙΧΝΕΥΤΗ ΒΑΡΥΤΙΚΩΝ ΚΥΜΑΤΩΝ
ΣΑΒΒΑΣ Π. ΓΑΒΡΙΗΛΙΔΗΣ



>

>

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