

$m \coloneqq 1$
 $l \coloneqq 1$

$v_0 \coloneqq 2 \cdot \sqrt{g \cdot l}$

$\varphi_0 \coloneqq \frac{10}{180} \, \pi$

$a \coloneqq l$

$g \coloneqq 9.80665$
 $k \coloneqq 0.2$

$\boxed{v_0} \coloneqq 0$

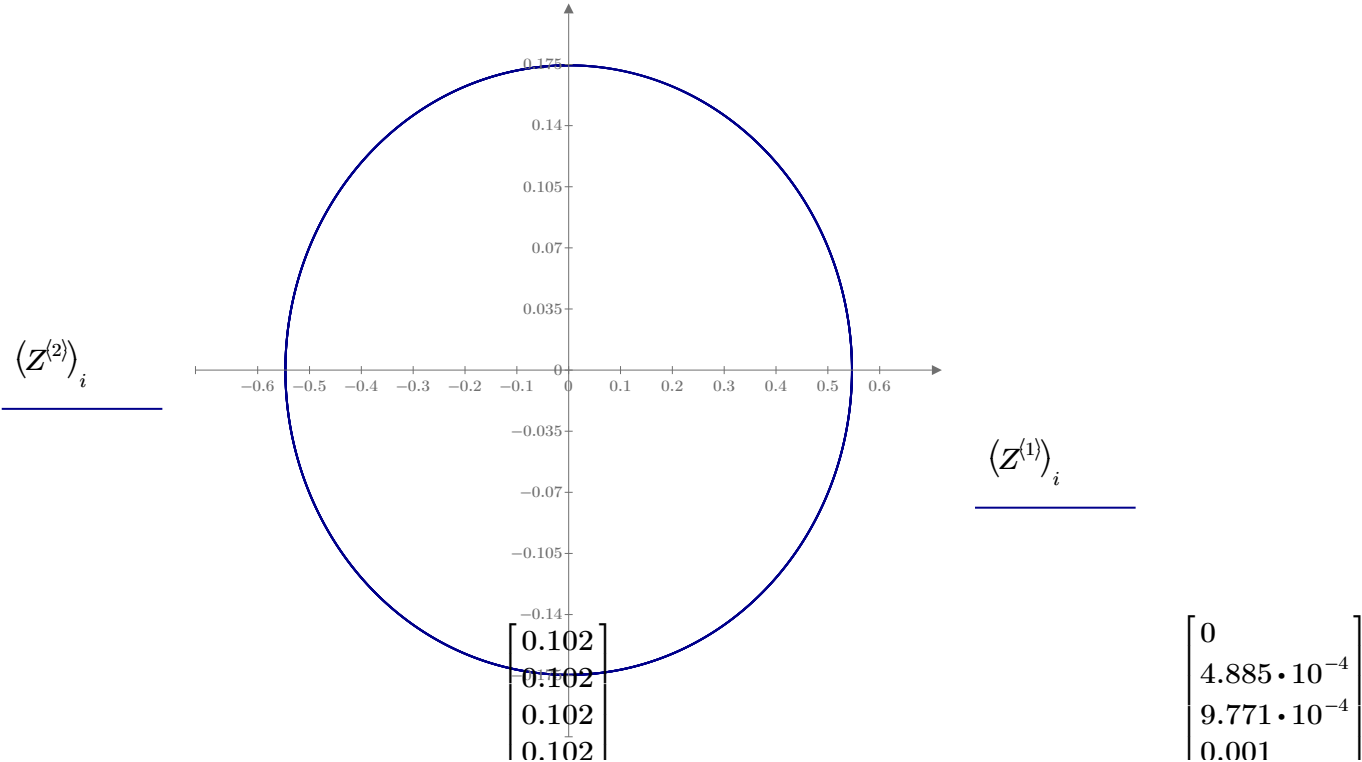
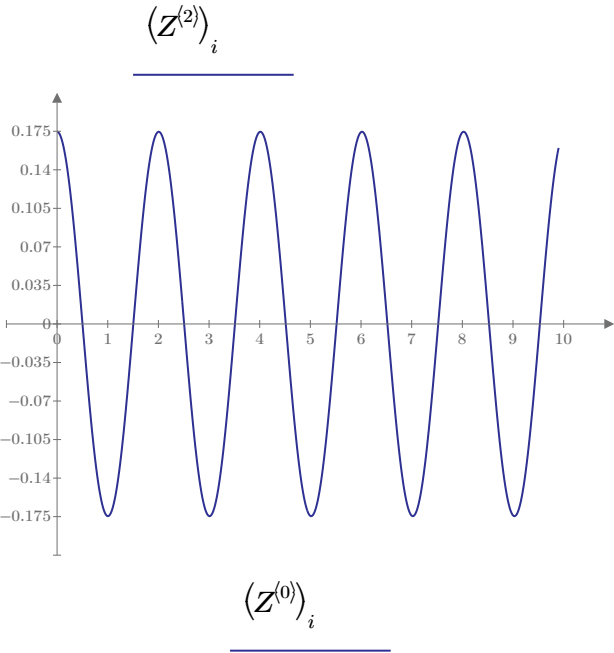
$y \coloneqq \begin{bmatrix} v_0 \\ \varphi_0 \end{bmatrix}$

$w_0 \coloneqq \sqrt{\frac{g}{l}}$

$$D(t,y) \coloneqq \begin{bmatrix} -w_0^2 \cdot y_1 \cdot 1 - 0 \cdot w_0^2 \cdot \sin(y_1) - k \cdot y_0 + a \cdot \sin(w_1 \cdot t) \\ y_0 \end{bmatrix}$$

$Z \coloneqq \text{rkfixed}(y,0,9.9,2000,D)$

$Z =$



$$A:=\frac{1}{\sqrt{\left(w_0^2-w^2\right)^2+4\left(\delta^2\cdot w^2\right)}}=\begin{bmatrix}0.102\\0.102\\0.102\\0.102\\0.102\\0.102\\0.103\\0.103\\ \vdots\end{bmatrix}\qquad \varphi:=\operatorname{atan}\left(\frac{2\cdot\delta\cdot w}{w_0^2-w^2}\right)=\begin{bmatrix}0.002\\0.002\\0.003\\0.003\\0.004\\0.004\\0.005\\0.005\\ \vdots\end{bmatrix}$$

$$v_0:=2\cdot\sqrt{g\cdot l}\qquad \varphi_0:=0\quad a:=l\quad g:=9.80665\quad k:=0.2\quad v_0:=\frac{\pi}{2}\qquad y:=\begin{bmatrix}v_0\\ \varphi_0\end{bmatrix}\qquad w_0:=\sqrt{\frac{g}{l}}$$

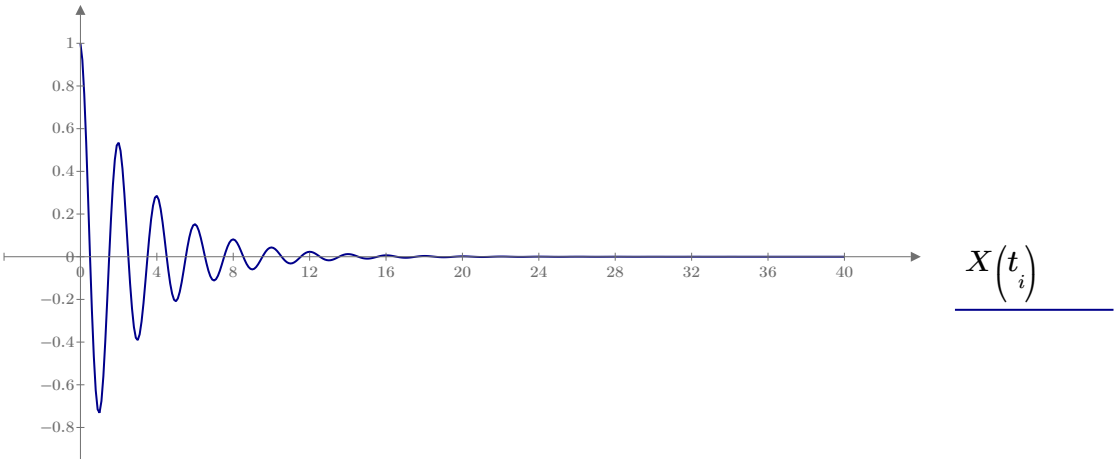
$$\begin{array}{l}w0\leftarrow\sqrt{\frac{g}{l}}\\h\leftarrow0.025\\d\leftarrow0.1\\w\leftarrow w0\cdot0.1\\v\leftarrow\frac{\pi}{24}\\phi i\leftarrow0\\i\leftarrow0\\m\leftarrow l\cdot\sin(\phi i)\\ \text{while }i<n\\ \quad\left\|\begin{array}{l}t\leftarrow h\cdot\left(a\cdot\sin(w\cdot i\cdot h)-w0^2\cdot\sin(\phi i)\right)\\ \phi i\leftarrow\phi i+h\cdot v\\ v\leftarrow v+t\\ i\leftarrow i+1\\ \text{if }\left(l\cdot\sin(\phi i)>m\right)\\ \quad\left\|\begin{array}{l}m\leftarrow l\cdot\sin(\phi i)\end{array}\right\|\end{array}\right\|\\ m\end{array}=1$$

$$R(t,y):=\begin{bmatrix}\frac{-g}{l}\cdot y_1\cdot 0-1\cdot w_0\cdot\sin\left(y_1\right)-k\cdot y_0+a\cdot\sin\left(w_0\cdot t\right)\\ y_0\end{bmatrix}$$

$$\left(A^{(i)}\right)_j:=\frac{A0}{m\cdot\sqrt{\left(w0^2-w_j^2\right)^2+4\,b_i^2\cdot w_j^2}}$$

$$t:=0,0.1..40=\begin{bmatrix}0\\ \vdots\end{bmatrix}$$

$$d:=0.1\qquad w0:=\sqrt{\frac{g}{l}}\qquad w:=w0\qquad f:=0\qquad m:=1\qquad l:=1\\ A0:=l\qquad b:=d\cdot w0\qquad X(t):=A0\cdot e^{-b\cdot t}\cdot\cos\left(w\cdot t+f\right)$$



$$\underline{t_i}$$

$$\boxed{n}:=1000$$

$$\boxed{m}:=3 \qquad step:=\frac{m}{n}$$

$$\boxed{k}:=0,step..m=\begin{bmatrix} 0 \\ 0.003 \\ 0.006 \\ \vdots \end{bmatrix}$$

$$z(t):=3\cdot\frac{t}{m} \qquad z(k)=\begin{bmatrix} 0 \\ 0.003 \\ 0.006 \\ \vdots \end{bmatrix}$$

$$\boxed{w}:=w0\cdot k=\begin{bmatrix} 0 \\ 0.009 \\ 0.019 \\ \vdots \end{bmatrix}$$

$$\boxed{d}:=0,0.01..10=\begin{bmatrix} 0 \\ \vdots \end{bmatrix}$$

$$\boxed{b}:=w0\cdot d$$

$$A_1:=\left\|\begin{array}{l} j\leftarrow 0 \\ \text{while } j\leq n \\ \left\|\begin{array}{l} (A)_j\leftarrow\frac{A0}{m\cdot\sqrt{\left(w0^2-w_j^2\right)^2+4\,b_{30}^2\cdot w_j^2}} \\ j\leftarrow j+1 \end{array}\right\| \\ A \end{array}\right\|$$

$$A_2:=\left\|\begin{array}{l} j\leftarrow 0 \\ \text{while } j\leq n \\ \left\|\begin{array}{l} (A)_j\leftarrow\frac{A0}{m\cdot\sqrt{\left(w0^2-w_j^2\right)^2+4\,b_{30}^2\cdot w_j^2}} \\ j\leftarrow j+1 \end{array}\right\| \\ A \end{array}\right\|$$

$$A_5:=\left\|\begin{array}{l} j\leftarrow 0 \\ \text{while } j\leq n \\ \left\|\begin{array}{l} (A)_j\leftarrow\frac{A0}{m\cdot\sqrt{\left(w0^2-w_j^2\right)^2+4\,b_{15}^2\cdot w_j^2}} \\ j\leftarrow j+1 \end{array}\right\| \\ A \end{array}\right\|$$

$$A_6:=\left\|\begin{array}{l} j\leftarrow 0 \\ \text{while } j\leq n \\ \left\|\begin{array}{l} (A)_j\leftarrow\frac{A0}{m\cdot\sqrt{\left(w0^2-w_j^2\right)^2+4\,b_{20}^2\cdot w_j^2}} \\ j\leftarrow j+1 \end{array}\right\| \\ A \end{array}\right\|$$

$$A_9:=\left\|\begin{array}{l} j\leftarrow 0 \\ \text{while } j\leq n \\ \left\|\begin{array}{l} (A)_j\leftarrow\frac{A0}{m\cdot\sqrt{\left(w0^2-w_j^2\right)^2+4\,b_{50}^2\cdot w_j^2}} \\ j\leftarrow j+1 \end{array}\right\| \\ A \end{array}\right\|$$

$$A_{10}:=\left\|\begin{array}{l} j\leftarrow 0 \\ \text{while } j\leq n \\ \left\|\begin{array}{l} (A)_j\leftarrow\frac{A0}{m\cdot\sqrt{\left(w0^2-w_j^2\right)^2+4\,b_{100}^2\cdot w_j^2}} \\ j\leftarrow j+1 \end{array}\right\| \\ A \end{array}\right\|$$

$$\|A\|_{J \leftarrow J^{\top} \mathbf{1}}$$

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