TRILOBIC VIBRANT SYSTEMS

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1. INTRODUCTION

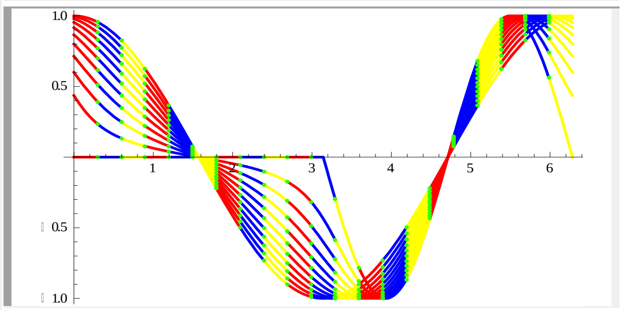
The trilobes are **ex-centric circular supermathematics functions** (**EC-SMF**) of angular ex-centricity **ε** = $\frac{\pi}{2}$, with notations ***cetθ*** and ***setθ***, for the trilobic ex-centric cosine and, respectively, the trilobic ex-centric sine, with equations:

$$(1)\quad \begin{cases} \boldsymbol{cet\theta} = \boldsymbol{cex}\left[\theta, S\left(\boldsymbol{s}, \frac{\pi}{2}\right)\right] = \cos\left\{\theta - arcsin\left[s.\sin\left(\theta - \frac{\pi}{2}\right)\right]\right\} = \mathbf{cos}[\boldsymbol{\theta} + \mathbf{arcsin}[\boldsymbol{s}.\boldsymbol{cos\theta}]] \\ \boldsymbol{set\theta} = sex\left[\theta, S\left(\boldsymbol{s}, \frac{\pi}{2}\right)\right] = \sin\left\{\theta - arcsin\left[s.\sin\left(\theta - \frac{\pi}{2}\right)\right]\right\} = \mathbf{sin}[\boldsymbol{\theta} + \mathbf{arcsin}[\boldsymbol{s}.\boldsymbol{cos\theta}]] \end{cases}$$

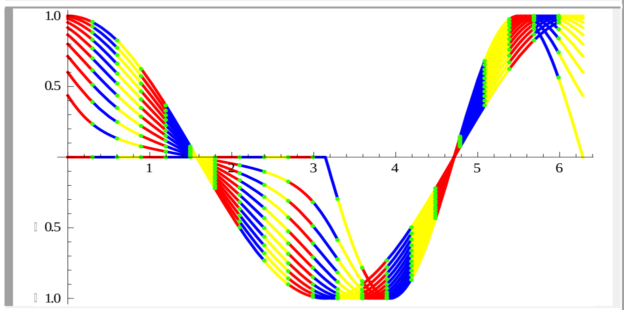
where **S** is a point, called **ex-center**, from the unity-circle plan of **CU**[O(0, 0), R = 1], of polar coordinates **S**(s,**ε**), where **s** ∈ [-1,+1] is the **numerical linear ex-centricity**, and **e** = Rs is the **real linear ex-centricity**, for any circle of radius **R,** and **ε** is the **angular ex-centricity**.

The graphics of **trilobic** ex-centric supermathematics functions (**TE-SMF**) are shown in **Figure 1**.

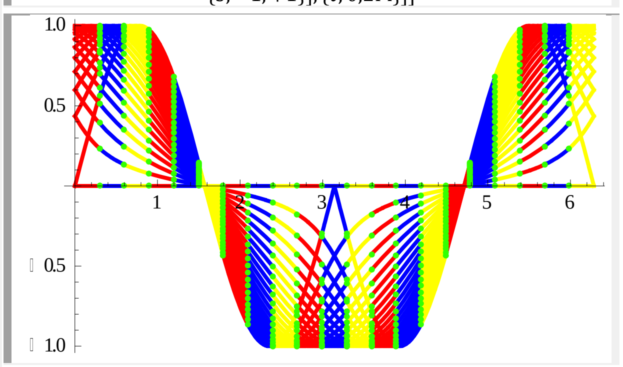
Plot[Evaluate[Table[{Cos[t + ArcSin[sCos[t]]]}, {s, −1,0}], {t, 0,2Pi}]]



Plot[Evaluate[Table[{Cos[t + ArcSin[sCos[t]]]}, {s, 0, +1}], {t, 0,2Pi}]]



Plot[Evaluate[Table[{Cos[t + ArcSin[sCos[t]]]}, {s, −1, +1}], {t, 0,2Pi}]]



ParametricPlot3D[{t, Cos[t + ArcSin[0.1sCos[t]]],0.1s}, {s, −10,10}, {t, 0,2Pi}]

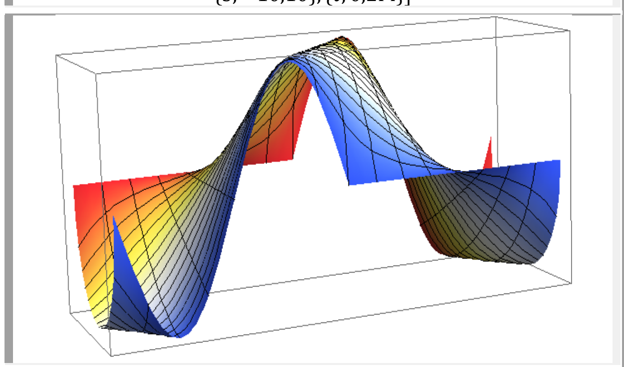
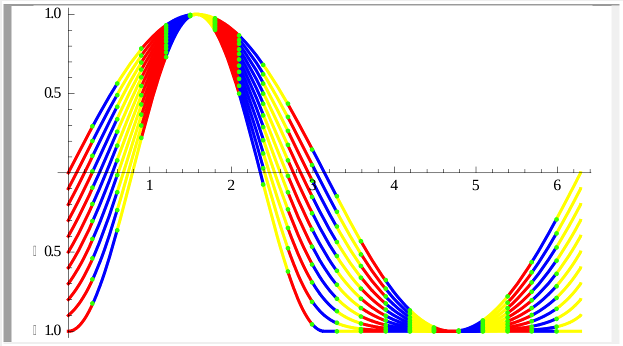
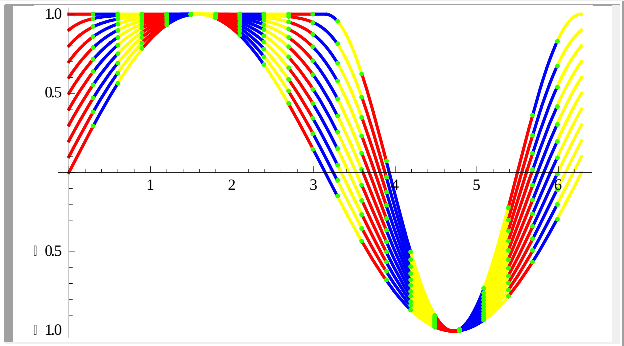


Fig. 1, a The graphics of **trilobic** functions **C** of ex-centric variable θ **cet**θ

Plot[Evaluate[Table[{Sin[t + ArcSin[sCos[t]]]}, {s, −1,0}], {t, 0,2Pi}]]

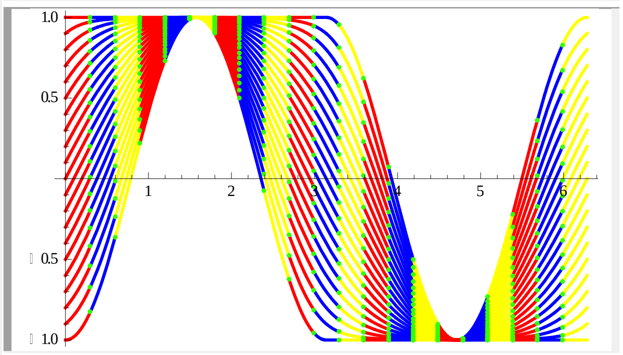
Plot[Evaluate[Table[{Sin[t + ArcSin[sCos[t]]]}, {s, 0,1}], {t, 0,2Pi}]]





Plot[Evaluate[Table[{Sin[+ArcSin[*s*Cos[*t*]]]}, {*s*, −1,1}], {*t*, 0,2Pi}]]

ParametricPlot3D[Evaluate[Table[{*t*, Sin[*t* + ArcSin[*s*Cos[*t*]]], *s*}, {*s*, −1,1}], {*t*, 0,2Pi}]]



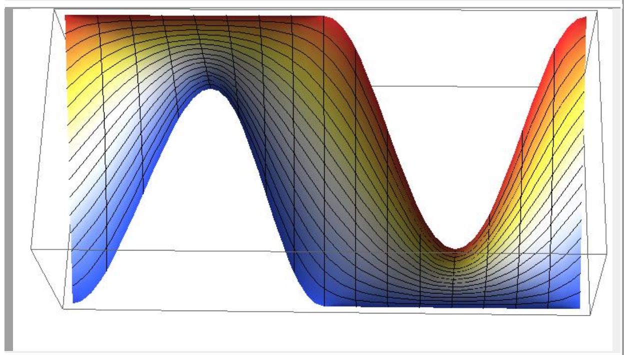
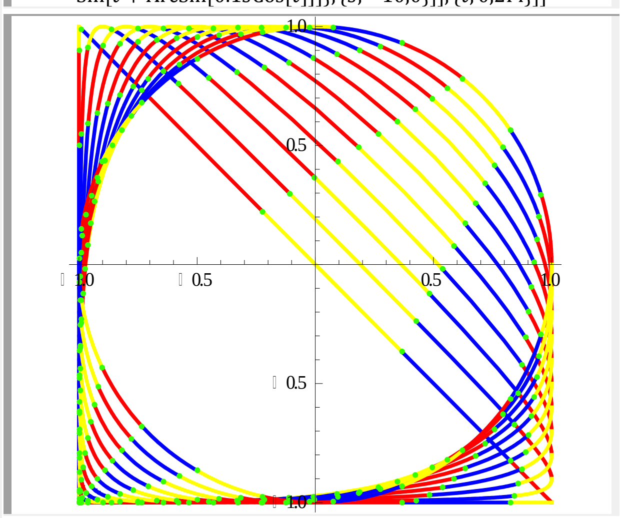
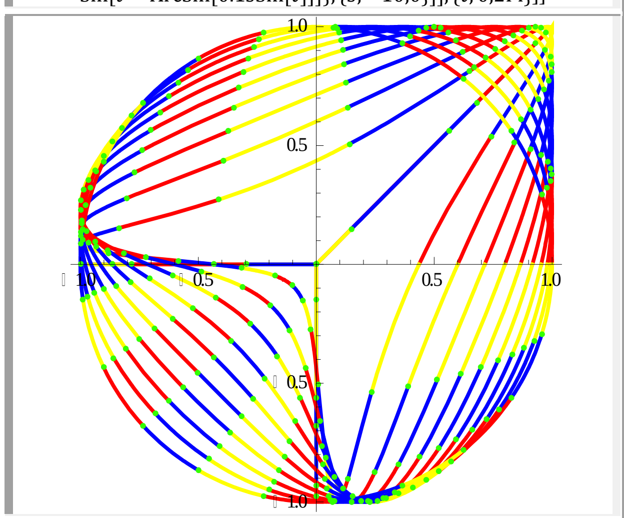


Fig. 1, b The graphics of **trilobic** functions **S** of ex-centric variable θ **set**θ

ParametricPlot[Evaluate[Table[{Cos[*t* − ArcSin[0.1*s*Sin[*t*]]], Sin[*t* + ArcSin[0.1*s*Cos[*t*]]]}, {*s*, −10,0}]], {*t*, 0,2Pi}]]

ParametricPlot[Evaluate[Table[{Cos[*t* + ArcSin[0.1*s*Cos[*t*]]], Sin[*t* − ArcSin[0.1*s*Sin[*t*]]]}, {*s*, −10,0}]], {*t*, 0,2Pi}]]





$\begin{cases} x = cex\theta \\ y = set\theta \end{cases}$ → **de** S(sinus) sau de **y**

$\begin{cases} x = cet\theta \\ y = cex\theta \end{cases}$ → **de** C(cosinus) sau de **x**

Fig. 2, a The graphics of **trilobes S (TS)** ◄ and of **trilobes C (TC)**► of ex-centric variable θ in **2D**

The trilobic ex-centric **supermathematics functions** are abbreviated as (**TE-SMF**).

It follows that, for a numerical linear ex-centricity **s** = 0, **TE-SMF** degenerates into **central circular functions** (**CC-SMF**) or **circular functions** / ordinary Euler trigonometric functions **cos**α and **sin**α (**s** = 0 → α ≡ **θ**), and for an angular ex-centricity **ε** = 0 and **s** ≠ 0, it degenerates in **EC-SMF cexθ** and, respectively, **sexθ.**

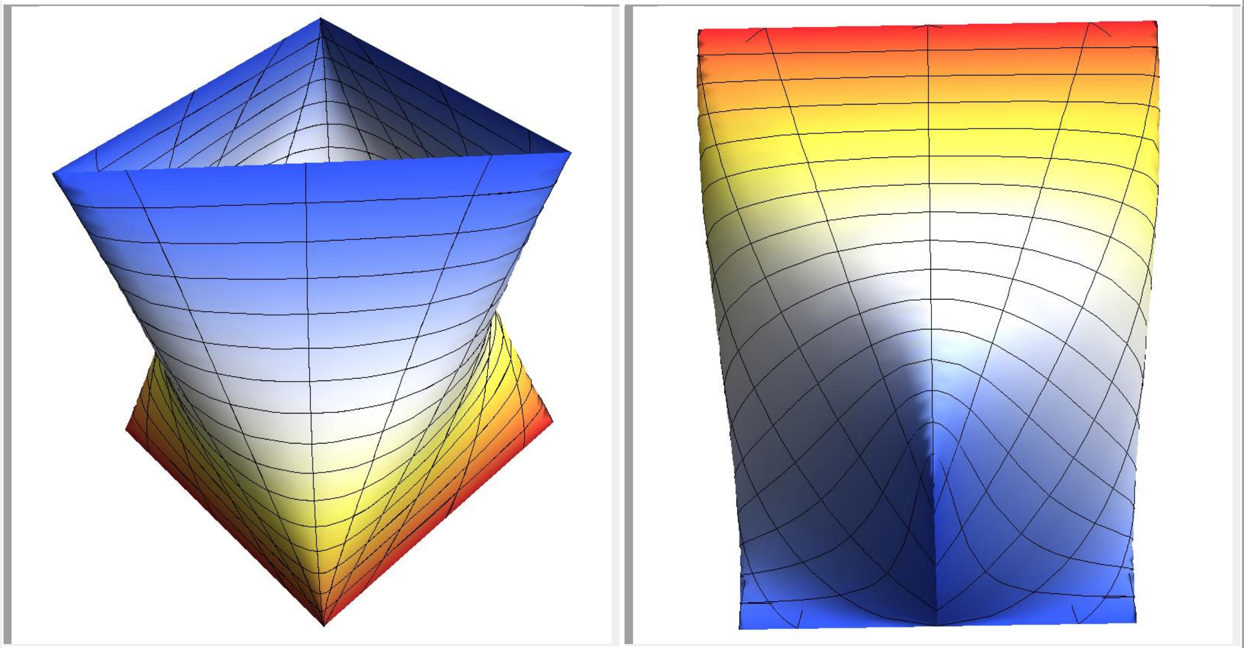


Fig. 2, b The graphics of **trilobes S**◄ and of **trilobes C**► of ex-centric variable θ in **3D**

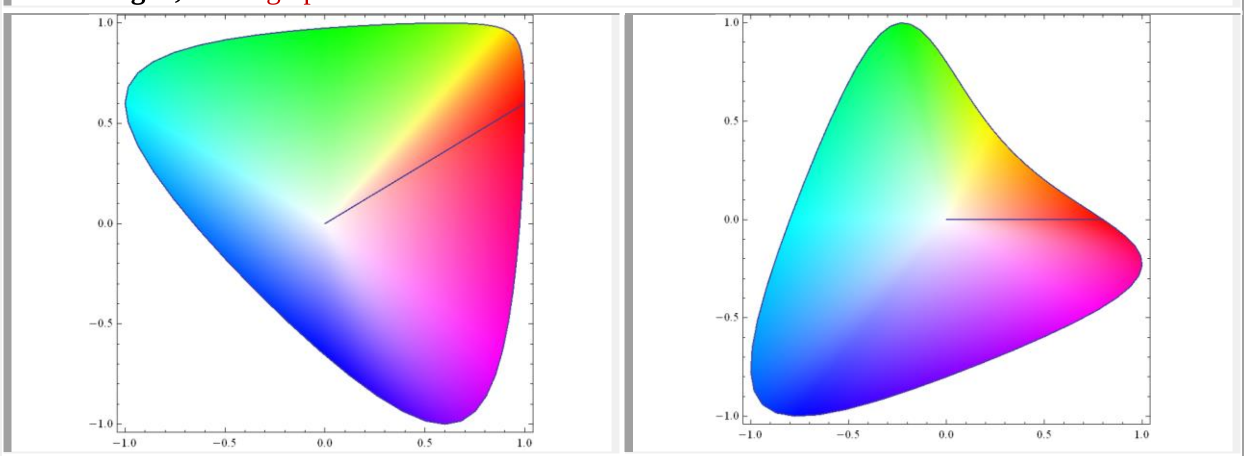


Fig. 2, c Trilobic disks S ◄and C► of s = 0,6

The term of TE-SMF derives from the fact that, for **s** ∈ (0, 1), the parametric equations, consisting of a combination of **EC-SMF** and **TE-SMF**, express closed plane curves of **3 lobes**, which, for **s** = 0, degenerates in a perfect circle and for **s** = ± 1 in a **rectangular isosceles triangle (TS)** or in an **ex-centric rectangular isosceles triangle** (TC) ◄, a figure in the shape of **inclined Y**, visible in the graphs of **Figures 2, a** ►.

2. DIFFERENTIAL EQUATION OF TRILOBIC VIBRANT SYSTEMS

Let us have the functions x(t), y(t) : ℝ→ [-1,+1] and **θ** = Ω.t

(1) $$\begin{cases} x(t) = \mathbf{cet}[\Omega t, \boldsymbol{S}(s,\varepsilon)] \\ y(t) = \boldsymbol{set}[\Omega t, \boldsymbol{S}(s,\varepsilon)] \end{cases}$$

of the same ex-center $\boldsymbol{S}(\boldsymbol{s},\boldsymbol{\varepsilon})$, where **s** is the polar radius and **ε** – the polar angle, in a unity-circle of radius **R** = 1→ CU(O,1).

Their derivatives, for $\theta = \Omega.t$ and $\frac{d\theta}{dt} = \Omega = 1$, are:

$$(2)\qquad \begin{cases}\dot{x}(t) = \frac{d}{dt}\text{cet}[\Omega t, S(s,\varepsilon)] = \frac{d\theta}{dt}\frac{d}{d\theta}\text{cet}[\theta, S(s,\varepsilon)] = \Omega.\frac{d}{d\theta}\text{cet}[\theta, S(s,\varepsilon)] = -\Omega.\,\text{det}\theta.\,\text{set}\theta \\ \dot{y}(t) = \frac{d}{dt}\text{set}[\Omega t, S(s,\varepsilon)] = \frac{d\theta}{dt}\frac{d}{dt}\text{set}[\theta, S(s,\varepsilon)] = \Omega.\frac{d}{d\theta}\text{set}[\theta, S(s,\varepsilon)] = +\Omega.\,\text{det}\theta.\,\text{cet}\theta\end{cases}$$

where $\Omega.\,\text{det}\theta = \omega$ and, explicitly:

$$(3)\qquad \begin{cases}\dot{x}(t) = -\Omega.\left(1 - \frac{s.\sin\theta}{\sqrt{1-s^2\cos\theta^2}}\right)\sin[\theta + \arcsin(s.\cos\theta] = -\,\omega.\,\text{set}\theta \\ \dot{y}(t) = \Omega.\left(1 + \frac{s.\sin\theta}{\sqrt{1-s^2.\,\cos^2\theta}}\right)\cos[\theta + \arcsin(s.\sin\theta)] = \omega.\,\text{cet}\theta\end{cases}$$

from where we get the expression **TE-SMF trilobic ex-centric derivative** of ex-centric variable θ:

$$(4)\qquad \text{det}\theta = 1 - \frac{s.\sin\theta}{\sqrt{1-s^2\cos\theta^2}} = \frac{d\alpha(\theta)}{d\theta} = \frac{\text{aet}\theta}{d\theta}$$, with graphics in **Figure 3**.

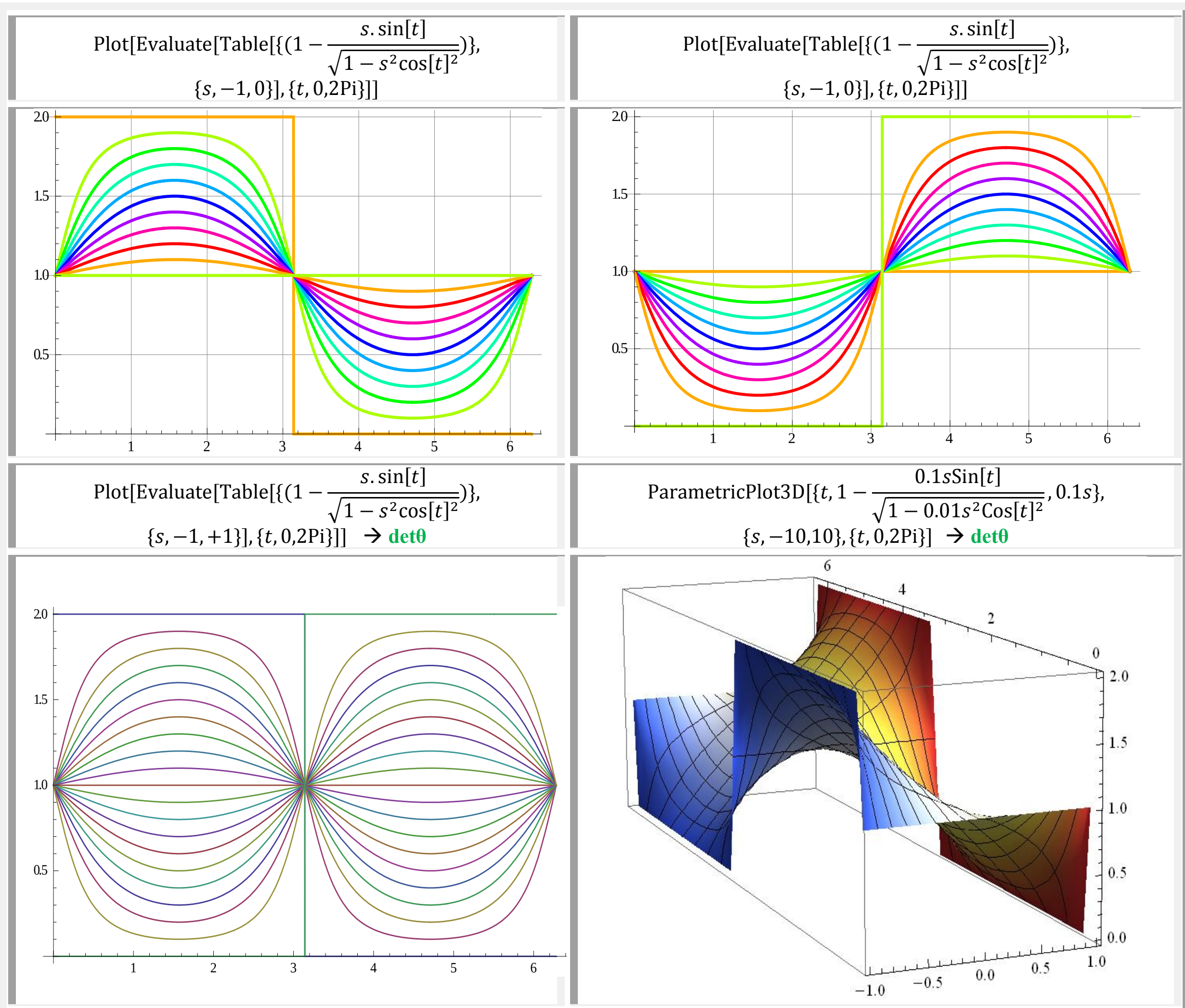


Fig. 3 The graphics **TE-SMF detθ** and the values of **wronskian** matrix $\Omega.\,\text{det}\theta$ of $\Omega = 1$ for **trilobic** vibrations

$\text{dex}\theta = 1 - \frac{s.\cos t}{\sqrt{1-s^2\sin^2\theta}}$	$\text{det}\theta = 1 - \frac{s.\sin t}{\sqrt{1-s^2\cos^2\theta}}$

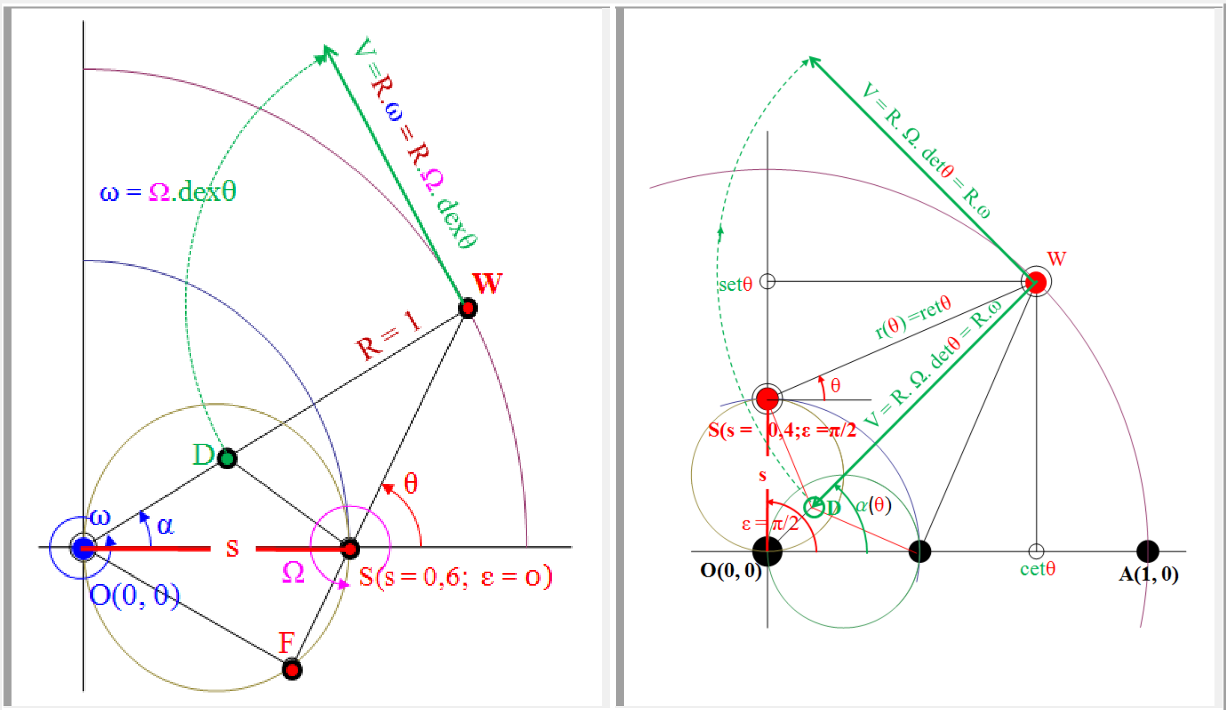


Fig. 4 Explanatory sketches of **EC-SMF dexθ** ◄ and **TE-SMF detθ** ►

The function **trilobic ex-centric amplitude aetθ** = α(θ) is represented by the angle α(θ) or by the **centric variable α**, to the center O(0, 0), as a function of angle θ to the ex-center **S**(**s**, $\frac{\pi}{2}$) or of **ex-centric variable θ** (**Fig. 4** ►), and $\boldsymbol{\Omega}.\boldsymbol{det\theta}$ = **ω(t)**, so that the second derivative of TE-SMF **(3)** is:

(5) $$\begin{cases}\ddot{x} = \frac{d}{dt}(-\omega.\boldsymbol{set\theta}) = -3.\boldsymbol{set\theta} - \boldsymbol{\omega^2}.\boldsymbol{cet\theta} \\ \ddot{y} = \frac{d}{dt}(\omega.\boldsymbol{cet\theta}) = 3.\boldsymbol{cet\theta} - \boldsymbol{\omega^2}.\boldsymbol{set\theta}\end{cases}$$

where we denoted by $3 = \frac{d\Omega}{dt}$ the angular acceleration of a moving point on the circle of parametric equations expressed by the relations (1), with variable angular speed (4), as it can be observed in **Figure 5,** following the angular distribution of colors.

The **wronskian** matrix of trilobic system of vibrations is:

(6) $$\begin{vmatrix} x(t) & y(t) \\ \dot{x}(t) & \dot{y}(t) \end{vmatrix} = \begin{vmatrix} \mathbf{cet}[\Omega t, \boldsymbol{S}(s,\varepsilon)] & \boldsymbol{set}[\Omega t, \boldsymbol{S}(s,\varepsilon)] \\ -\Omega.\boldsymbol{det\theta}.\boldsymbol{set\theta} & +\Omega.\boldsymbol{det\theta}.\boldsymbol{cet\theta} \end{vmatrix} = \Omega.\boldsymbol{det\theta}\left[\mathbf{cet^2\theta}.+\boldsymbol{set^2\theta}\right] = \boldsymbol{\Omega}.\boldsymbol{det\theta}$$

because $\boldsymbol{cet^2\theta} + \boldsymbol{set^2\theta} = \mathbf{1}$, as well as their counterparts $\mathbf{cex^2\theta} + \boldsymbol{sex^2\theta} = \mathbf{1}$, as well as their **ancestor** / **precursor** archaics $\mathbf{cos^2\alpha + sin^2\alpha = 1}$.

The graphics of **wronskian** matrix, for $\boldsymbol{\Omega}$ = 1, are shown in **Figure 3**, from where it can be inferred that the values are strictly positive for |***s***| < 1 and, by consequence, there is a **linear differential equation**, of a dynamic technical system, of nonlinear elastic property, admitting these functions as fundamental system of solutions.

The fundamental system of solutions is:

(7) $Z = C_1\ \text{cet}\Omega t + C_2 \text{set}\Omega t$,

where $C_1, C_2 \in \mathbb{R}$ are constant and (7) is the general solution of the following differential equation.

The equations is:

(8) $$\begin{vmatrix} z & x & y \\ \dot{z} & \dot{x} & \dot{y} \\ \ddot{z} & \ddot{x} & \ddot{y} \end{vmatrix} = 0$$

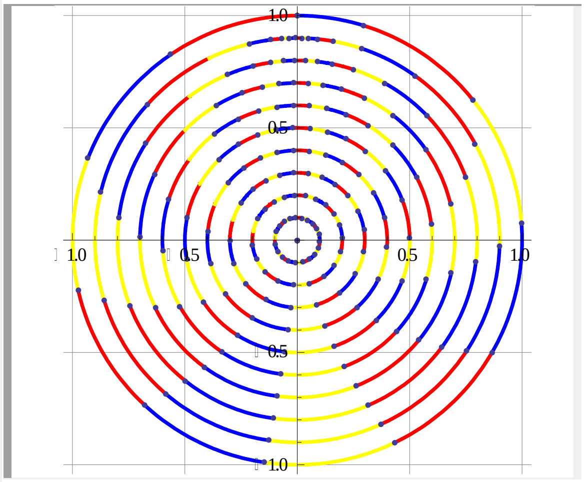
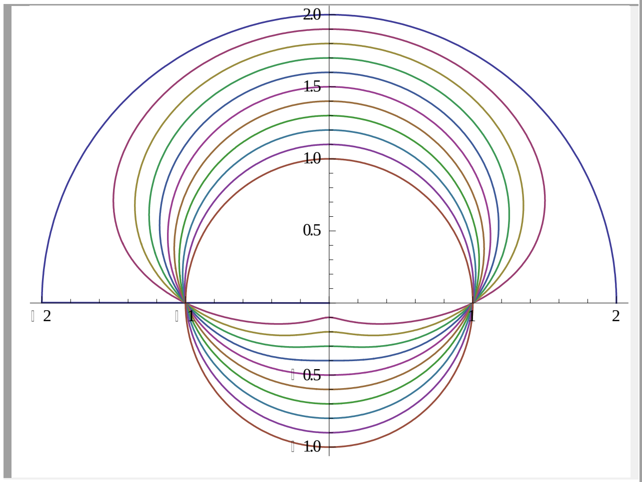
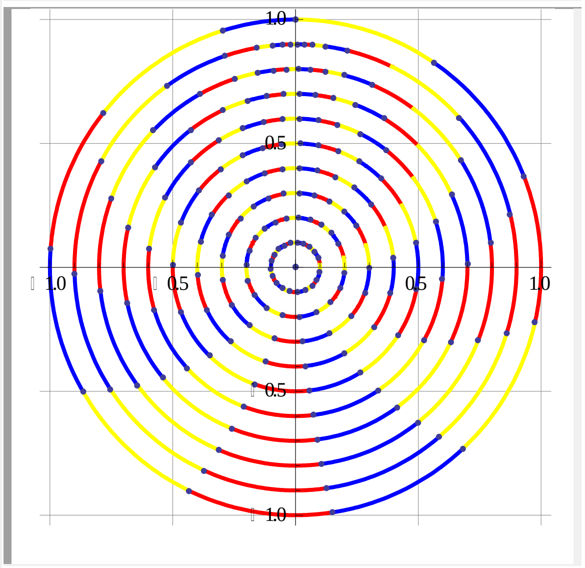
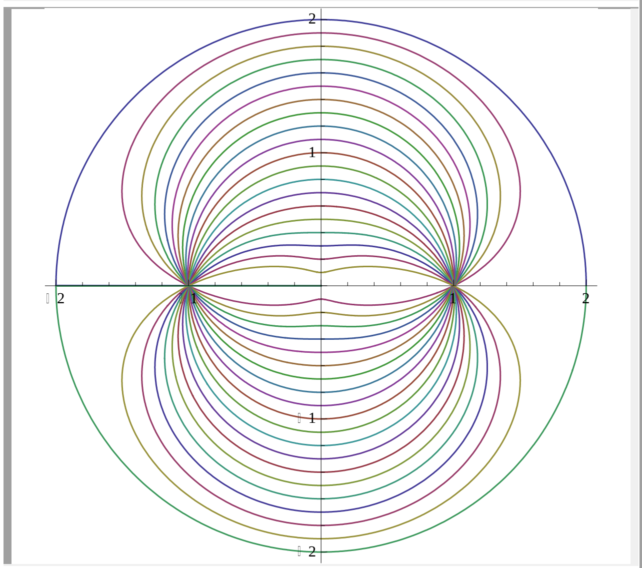
ParametricPlot[Evaluate[Table[{sCos[t + ArcSin[sCos[t]]], sSin[t + ArcSin[sCos[t]]]}, {s, −1, 0}]]	**PolarPlot**[$\sqrt{\dot{x}^2+\dot{y}^2}$ = $det\theta$] ,**s** ∈**[-1 ,0]**
	
ParametricPlot[Evaluate[Table[{s. Cos[t + ArcSin[sCos[t]]], s. Sin[t + ArcSin[sSin[t]]]}, {s, 0,1}], {t, 0,2Pi}]]	**PolarPlot**[$\sqrt{\dot{x}^2+\dot{y}^2}$ = $det\theta$] ,**s** ∈**[-1,1]**
	

Fig. 5 The trajectory of a trilobic moving point, on the circles of equations **(1),** of variable radius **R = 0,1s,** with **s ∈ [0, 1]** ◄ and the speeds in polar coordinates for **R = 1** and **s** ∈ [-1,+1]▼►

(9) $$\ddot{\boldsymbol{z}}\begin{vmatrix} x & y \\ \dot{x} & \dot{y} \end{vmatrix} - \dot{\boldsymbol{z}}\begin{vmatrix} x & y \\ \ddot{x} & \ddot{y} \end{vmatrix} + \boldsymbol{z}\begin{vmatrix} \dot{x} & \dot{y} \\ \ddot{x} & \ddot{y} \end{vmatrix} = 0$$

(8’) $$\begin{vmatrix} z & cet\boldsymbol{\theta} & set\boldsymbol{\theta} \\ \dot{z} & -\boldsymbol{\omega}.set\boldsymbol{\theta} & \boldsymbol{\omega}.cet\boldsymbol{\theta} \\ \ddot{z} & -3.set\boldsymbol{\theta} - \boldsymbol{\omega}^2.cet\boldsymbol{\theta} & 3.cet\boldsymbol{\theta} - \boldsymbol{\omega}^2.set\boldsymbol{\theta} \end{vmatrix} = 0$$

(8’) $$\ddot{\boldsymbol{z}}\begin{vmatrix} cet\boldsymbol{\theta} & set\boldsymbol{\theta} \\ -\boldsymbol{\omega}.set\boldsymbol{\theta} & \boldsymbol{\omega}.cet\boldsymbol{\theta} \end{vmatrix} - \dot{\boldsymbol{z}}\begin{vmatrix} cet\boldsymbol{\theta} & set\boldsymbol{\theta} \\ -3.set\boldsymbol{\theta}\ddot{-}\boldsymbol{\omega}^2.cet\boldsymbol{\theta} & 3.cet\boldsymbol{\theta} - \boldsymbol{\omega}^2.set\boldsymbol{\theta} \end{vmatrix} +$$

$$z\begin{vmatrix} -\omega.set\theta & \omega.cet\theta \\ -3.set\theta - \omega^2.cet\theta & 3.cet\theta - \omega^2.set\theta \end{vmatrix} = 0$$

(10) $\ddot{z}.\omega(cet^2\theta + set^2\theta) - \dot{z}.[3.cet^2\theta - \omega^2.cet\theta set\theta + 3.set^2\theta + \omega^2.cet\theta.set\theta] + z[-3.\omega.cet\theta set\theta + \omega^3.set^2\theta + 3.\omega set\theta.cet\theta + \omega^3.cet^2\theta] = 0$

(10') $\ddot{z}.\omega - \dot{z}.3 + z.\omega^3 = 0$

or

(10'') $\ddot{z} - \dot{z}\frac{3}{\omega} + z.\omega^2 = 0$

which is the differential equation of open, unamortized vibrations, of trilobic mechanical systems, identical equation, **in form**, with the equation of open, unamortized vibrations of **ex-centric** systems, and with the equation of **quadrilobic** ones.

3. INTEGRAL CURVES IN THE PHASE PLANE

The integral curves are the plane curves described by the speed points rotating on the unity-circle of R = 1, or on another circle of radius equally to the maximum amplitude of oscillation **R** = A, according to their projection position on the axis Ox, i.e. V(x) and are sunt shown in **Figure 6**.

Their parametric equations are:

- for trilobes C

(11) $\begin{cases} x = cet\theta \\ y = -\Omega.det\theta.set\theta \end{cases}$

- for trilobes S

(12) $\begin{cases} x = set\theta \\ y = \Omega.det\theta.cet\theta \end{cases}$

with graphics in **Figure 6, a** and, respectively, **6, b**.

ParametricPlot[Evaluate[Table[{cos[x + arcsin[$s$cos[x]]], sin[x + arcsin[$s$cos[x]]] (1 − s sin[x]/Sqrt[1 − ($s$cos[x])²])}, {s, −1, 1}], {x, 0, 2Pi}] → **V(x_C)**

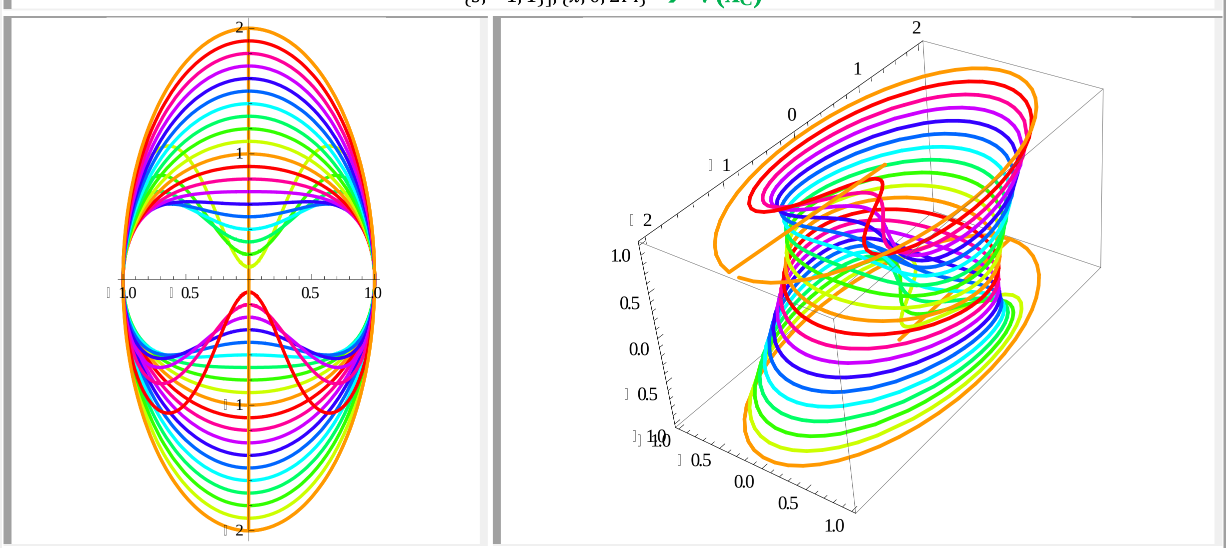


Fig. 6, a Integral curves of open, unamortized vibrations of **trilobic** mechanical systems **C** in the phase plane

In the case of open, unamortized vibrations, there are only two forces in the system:

- the force exerted by the elastic element of the system, proportional to the movement x, namely

(13) $\quad F_{el} = \mathbf{k}.\mathbf{x} = \begin{cases} \boldsymbol{k}.\boldsymbol{cet}\Omega t \\ \boldsymbol{k}.\boldsymbol{set}\Omega t \end{cases}$,

where k is an elastic constant of the element and the acceleration force, proportional to the **mass m** of the oscillating system and to the mass acceleration of the system, i.e.

ParametricPlot[Evaluate[Table[{sin[x + arcsin[$s$cos[x]]], cos[x + arcsin[sCos[x]]](1 − s sin[x]/Sqrt[1 − ($s$cos[x])^2])}
,{s, −1,1}], {x, 0,2Pi} → **V(x$_S$)**

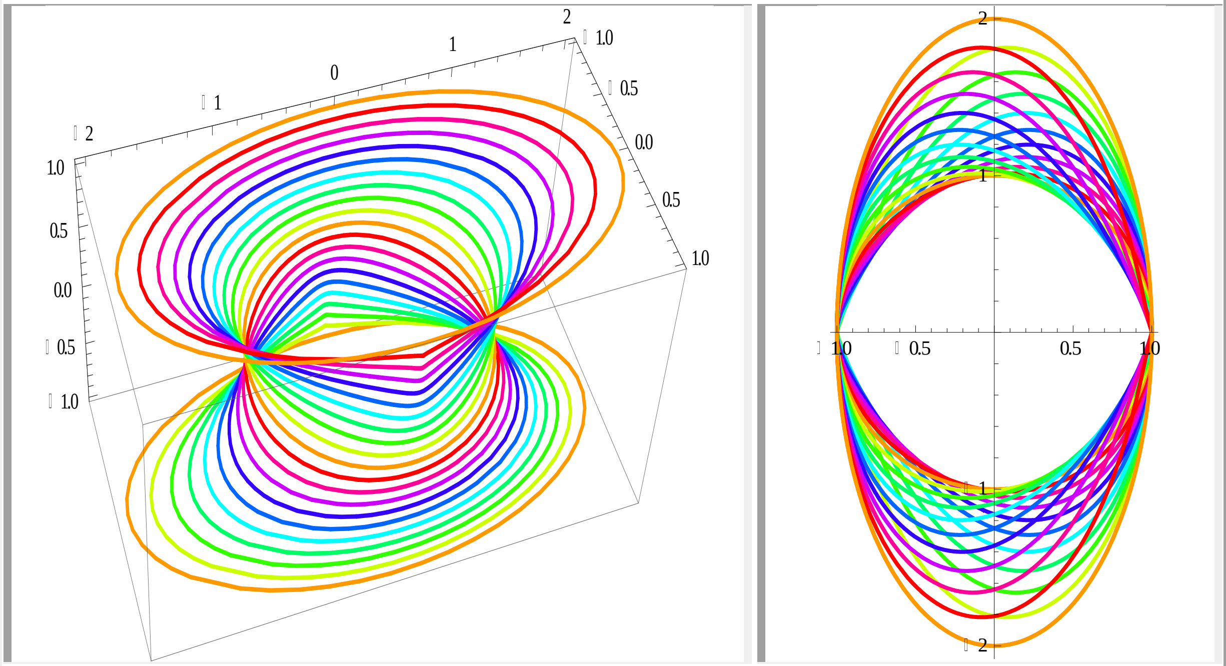


Fig. 6, b Integral curves of **trilobic** mechanical systems of open, unamortized vibrations **S** in the phase plane

(14) $\quad \mathbf{F_{acc}} = m.\ddot{x} = \begin{cases} \boldsymbol{m}(-3.\boldsymbol{set\theta} - \omega^2.\boldsymbol{cet\theta}) \\ \boldsymbol{m}(+3.\boldsymbol{cet\theta} - \omega^2.\boldsymbol{set\theta}) \end{cases}$

4. STATIC ELASTIC PROPERTIES (SEP) OF TRILOBIC OSCILLATING SYSTEMS

Since there are only two forces in the considered system, under condition of dynamic equilibrium, they must be equal and of contrary signs / directions, meaning that

(15) $\quad F_{el} + \mathbf{F_{acc}} = 0, \quad \rightarrow \quad F_{el} = -\ \mathbf{F_{acc}}$

and, as a result, the **static elastic properties** (**SEP**) of **trilobic systems** are expressed by the parametric equations:

(16) $\quad \begin{cases} x = \boldsymbol{cet\theta} \\ y = \ddot{x} = -(-3.\boldsymbol{set\theta} - \omega^2.\boldsymbol{cet\theta}) \end{cases}$

and, explicitly, for **trilobic systems C**:

(16') $\quad \begin{cases} x = \cos[\theta + \arcsin(s.cos\theta] \\ y = \ -(-\cos[x + \arcsin[s\mathrm{Cos}[x]]] \left(1 - \frac{s.\sin[x]}{\sqrt{1-s^2\cos[x]^2}}\right)^2 - (-\frac{s\cos[x]}{\sqrt{1-s^2\cos[x]^2}} + \frac{\cos[x]\sin[x]^2}{(1-1s^2\cos[x]^2)^{3/2}})\sin[x + \arcsin[s.\cos[x]]]) \end{cases}$

with graphics in **Figure 7** ⮝, while for **trilobic systems S**, the parametric equations are:

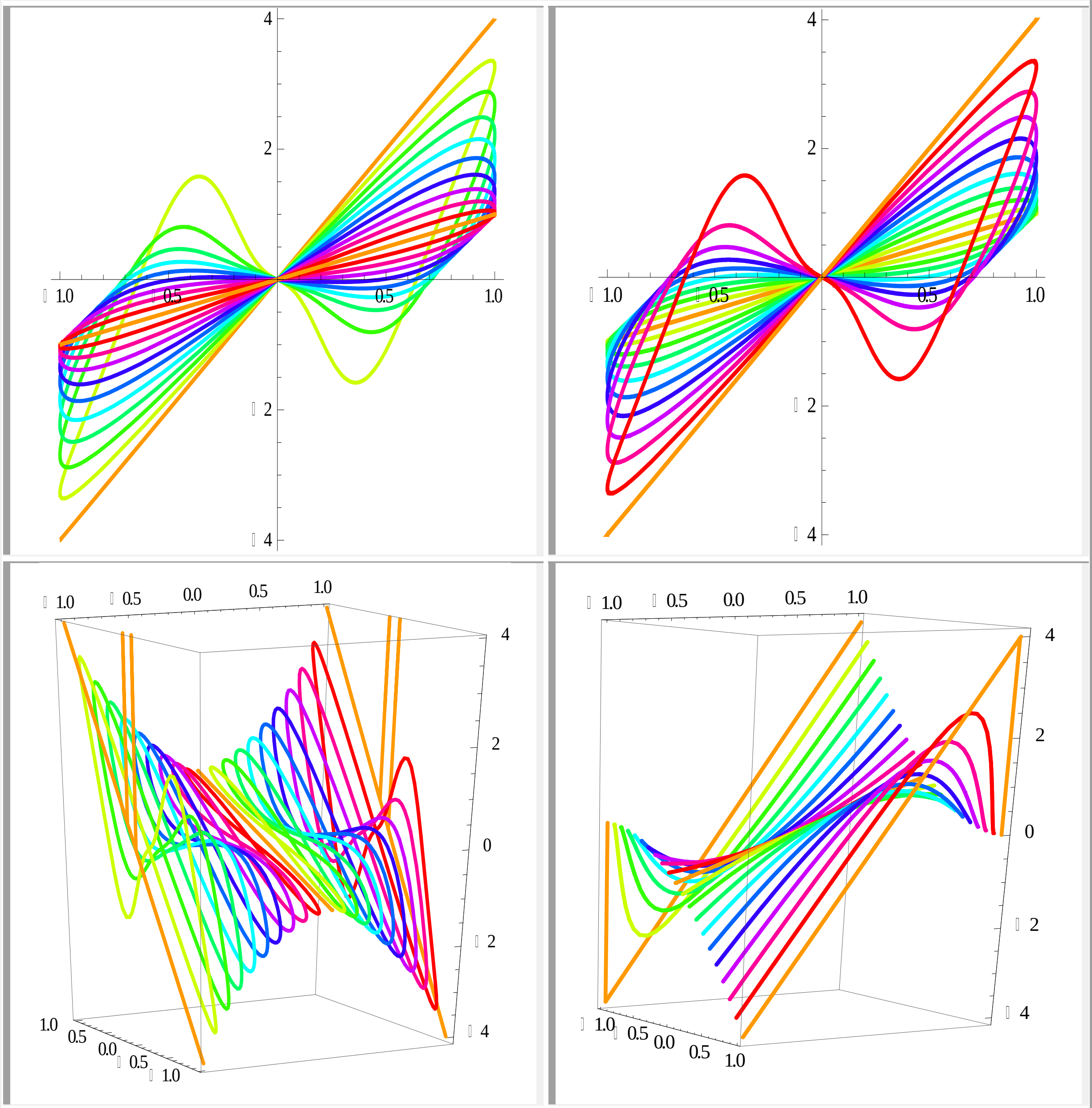
(17) $\quad \begin{cases} x = \boldsymbol{set\theta} \\ y = \ddot{y} = \ -(3.\boldsymbol{cet\theta} - \omega^2.\boldsymbol{set\theta}) \end{cases}$

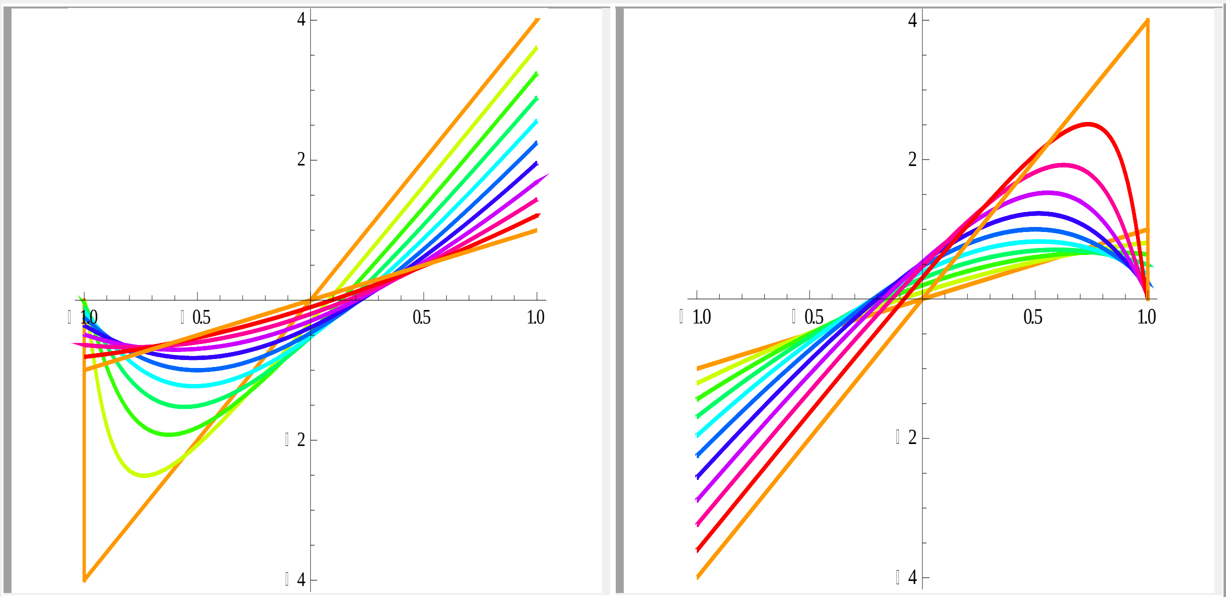
and, explicitly:

$$(17')\quad \begin{cases} x = \sin[\theta + \arcsin(s.\,cos\theta)] \\ y = -(\cos[x + \arcsin[s.\cos[x]]](-\frac{s\cos[x]}{\sqrt{1-s^2\cos[x]^2}} + \frac{s^3\cos[x]\sin[x]^2}{(1-s^2\cos[x]^2)^{3/2}}) - \left(1 - \frac{s.\sin[x]}{\sqrt{1-s^2\cos[x]^2}}\right)^2 \sin[x + \arcsin[s.\cos[x]]]) \end{cases}$$

with graphics in **Figure 7⩡.**

$$\text{ParametricPlot[Evaluate[Table[}\{\cos[x + \arcsin[s\cos[x]]], -(-\cos[x + \arcsin[s\text{Cos}[x]]]\left(1 - \frac{s.\sin[x]}{\sqrt{1 - s^2\cos[x]^2}}\right)^2 - (-\frac{s\cos[x]}{\sqrt{1 - s^2\cos[x]^2}} + \frac{\cos[x]\sin[x]^2}{(1 - 1s^2\cos[x]^2)^{3/2}})\sin[x + \arcsin[s.\cos[x]]])\}, \{s, -1, 0\}], \{x, 0, 2\text{Pi}\}]$$





$$\text{ParametricPlot[Evaluate[Table[\{sin}[x+\text{arcsin}[s.\cos[x]]],-(\cos[x+\text{arcsin}[s.\cos[x]]](-\frac{s\cos[x]}{\sqrt{1-s^2\cos[x]^2}}+\frac{s^3\cos[x]\sin[x]^2}{(1-s^2\cos[x]^2)^{3/2}})$$

$$-\left(1-\frac{s.\sin[x]}{\sqrt{1-s^2\cos[x]^2}}\right)^2\sin[x+\text{arcsin}[s.\cos[x]]]])\},\{s,0,1\}],\{x,0,2\text{Pi}\}$$

Fig.7 Static Elastic Properties (SEP) of **trilobic** mechanical systems of vibrations
C ⋏ and S⋎ , open, unamortized

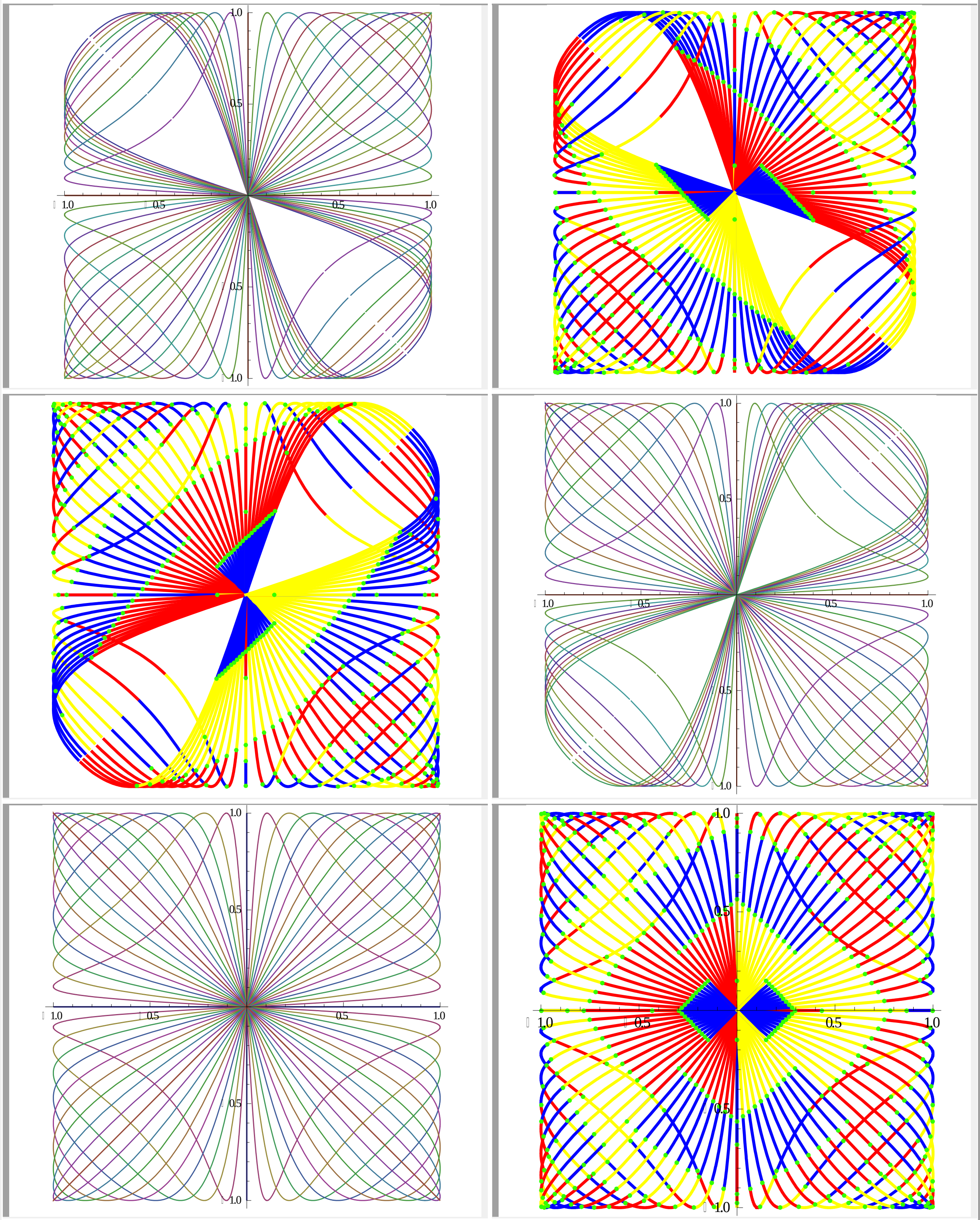
From graphics in **Figure 7,** it follows that **SEP** **linear** for **s = 0**, as it was expected, since we are in this case in the **centric field**, of classical linear systems of vibrations, expressed by circular centric functions **cosα** and **sinα,** but also for **s = ± 1**, which is a less expected result, even a surprise, which also appeared with the other systems expressed by **supermathematic functions** mentioned above (**quadrilobes**, expressed by **quadrilobic functions coqθ** and **siqθ**, but alo by **SMF- ex-centric circular,** by functions **cexθ** and **sexθ**).

REFERENCES

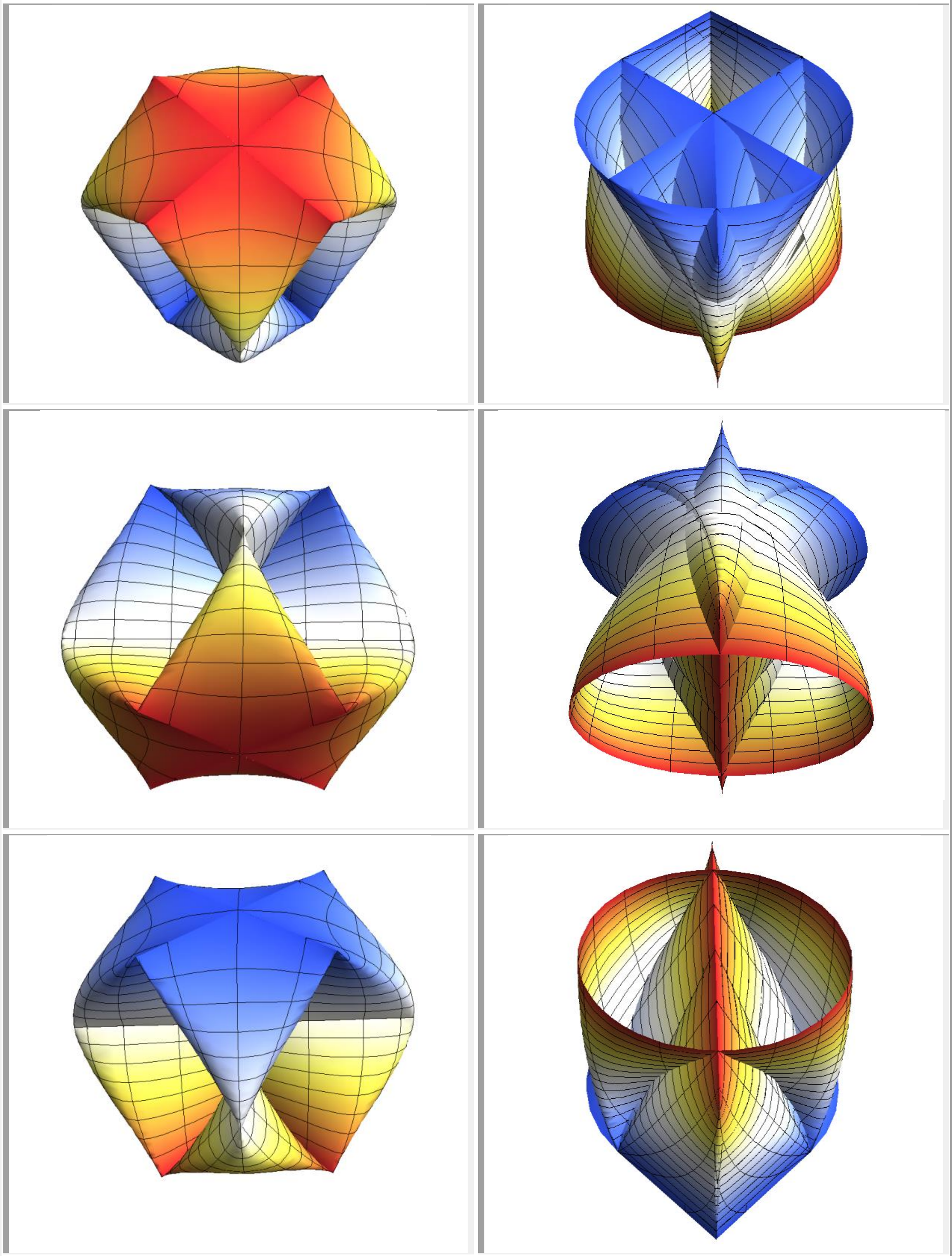
1	Şelariu Mircea Eugen	**STUDIUL VIBRAŢIILOR LIBERE ALE UNUI SISTEM NELINIAR, CONSERVATIV CU AJUTORUL FUNCŢIILOR CIRCULARE EXCENTRICE**	Com. I Conf. Naţ. Vibr.în C.M. Timişoara, 1978, pag. 95...100
2	Şelariu Mircea Eugen	**FUNCŢIILE SUPERMATEMATICE CIRCULARE EXCENTRICE cexθ şi sexθ DE VARIABILĂ EXCENTRICĂ θ – SOLUŢIILE UNOR SISTEME MECANICE NELINIARE**	Com. A VII-a Conf.Naţ. V.C.M., Timişoara, 1993, pag. 275…284.
3	Şelariu Mircea Eugen	**FUNCŢIILE SUPERMATEMATICE CIRCULARE EXCENTRICE Cexα** şi **Sexα DE VARIABILĂ CENTRICĂ α CA SOLUŢII ALE UNOR SISTEME OSCILANTE NELINIARE**	TEHNO '98. A VIII-a Conferinţa de Inginerie Managerială şi Tehnologică, Timişoara 1998, pag 557…572
4	Şelariu Mircea Eugen	**QUADRILOBIC VIBRATION SYSTEMS**	The 11th International Conference on Vibration Engineering, Timişoara, Sept. 27-30, 2005 pag. 77 … 82

5	Şelariu Mircea Eugen	**SUPERMATEMATICA. FUNDAMENTE,** Second edition, Vol. I and Vol. II	Editura POLITEHNICA, Timişoara, 2012
6	Şelariu Mircea Eugen	**SUPERMATEMATICA. FUNDAMENTE,**	Editura POLITEHNICA, Timişoara, 2007
7	Şelariu Mircea Eugen	**FUNCŢII CIRCULARE EXCENTRICE**	Com. I Conferinţă Naţională de Vibraţii în Construcţia de Maşini, Timişoara, 1978, pag.101...108.
8	Şelariu Mircea Eugen	**FUNCŢII CIRCULARE EXCENTRICE şi EXTENSIA LOR.**	Bul. St.şi Tehn. al I.P. ”TV” Timişoara, Seria Mecanică, Tomul 25(39), Fasc. 1-1980, pag. 189...196
9	Şelariu Mircea Eugen	**RIGIDITATEA DINAMICĂ EXPRIMATĂ CU FUNCŢII SUPERMATEMATICE**	Com.VII Conf. Internaţ. De Ing. Manag. Si Tehn., TEHNO ’95 Timişoara, 1995 Vol.7 : Mecatronică, Dispoz. Si Rob. Ind., pag. 185…194
10	Şelariu Mircea Eugen	**DETERMINAREA ORICÂT DE EXACTĂ A RELAŢIEI DE CALCUL A INTEGRALEI ELIPTICE COMPLETE DE SPETA ÎNTÂIA K(k)**	Bul. VIII-a Conf. De Vibr. Mec., Timişoara, 1996, Vol III, pag.15 ... 24.
11	Şelariu Mircea Eugen	**SMARANDACHE STEPPED FUNCTIONS**	“Scienta Magna” Vol. 3, No. 1, 2007, ISSN 1556-6706
12	Şelariu Mircea Eugen	**TEHNO ART OF ŞELARIU SUPERMATHEMATICS FUNCTIONS**	(ISBN-10):1-59973-037-5 (ISBN-13):974-1-59973-037-0 (EAN): 9781599730370
13	Preda Horea	**REPREZENTAREA ASISTATĂ A TRAIECTORILOR ÎN PLANUL FAZELOR A VIBRAŢIILOR NELINIARE**	Com. VI-a Conf. Naţ. Vibr. în C.M. Timişoara, 1993
15	Smarandache Florentin Şelariu Mircea Eugen	**IMMEDIATE CALCULATION OF SOME POISSON TYPE INTEGRALS USING SUPERMATHEMATICS CIRCULAR EX-CENTRIC FUNCTIONS**	http://arxiv.org/abs/0706.4238 Archiv arXiv (United States) viXra.org > Functions and Analysis > viXra:1004.0053
16	Şelariu Mircea Eugen	**MIŞCAREA CIRCLARĂ EXCENTRICĂ. PENDULUL SUPERMATEMATIC**	www.cartiaz.ro pag. 3
17	Şelariu Mircea Eugen	**ELEMENTE NELINIARE LEGATE ÎN SERIE**	www.cartiaz.ro pag. 3
18	Şelariu Mircea Eugen	**RIGIDITATEA DINAMICĂ EXPRIMATĂ CU FUNCŢII SUPERMATEMATICE**	www.cartiaz.ro pag. 4
19	Şelariu Mircea Eugen	**OPTIMIZAREA TRANSPORTULUI VIBRAŢIONAL CU AJUTORUL FUNCŢIILOR SUPERMATEMATICE CIRCULARE EXCENTRICE (FSM-CE)**	www.cartiaz.ro pag. 4
20	Şelariu Mircea Eugen	**O METODA NOUA DE INTEGRARE. INTEGRAREA PRIN DIVIZAREA DIFERENŢIALEI**	www.cartiaz.ro pag. 4
21	Şelariu Mircea Eugen	**INTEGRALE SI FUNCŢII ELIPTICE EXCENTRICE**	www.cartiaz.ro pag. 4
22	Şelariu Mircea Eugen	**LOBELE - CURBE MATEMATICE NOI**	www.cartiaz.ro pag. 6

ANEXA 1



Quasitrilobes in 2D



Quasitrilobes in 3D