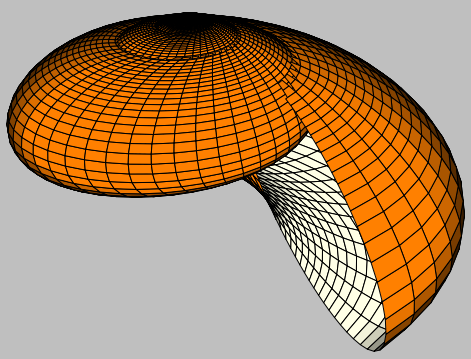
PSTricks

pst-shell

Plotting sea shells; v.0.03

June 14, 2026



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Contents

1 The Equations

The geometric modeling of seashells was carried out by M. B. Cortie. In the document "DIGITAL SEASHELLS," he provides the parametric equations, which are functions of 14 parameters, in order to allow the modeling of a very large number of seashells. [2]

$$\begin{cases} x = D[A\sin\beta\cos\theta + R\cos(s+\phi)\cos(\theta+\Omega) - R\sin\mu\sin(s+\phi)\sin(\theta+\Omega)]e^{\theta\cot\alpha} \\ y = D[-A\sin\beta\sin\theta - R\cos(s+\phi)\sin(\theta+\Omega) - R\sin\mu\sin(s+\phi)\cos(\theta+\Omega)]e^{\theta\cot\alpha} \\ z = [-A\cos\beta + R\sin(s+\phi)\cos\mu]e^{\theta\cot\alpha} \end{cases}$$

$$\begin{aligned} R &= R_e + k \\ R_e &= \frac{1}{\sqrt{\frac{\cos^2(s)}{a^2} + \frac{\sin^2(s)}{b^2}}} \\ k &= L\mathbf{exp}\left(-\left[\frac{2(s-P)}{W_1}\right]^2 - \left[\frac{2f(\theta)}{W_2}\right]^2\right) \\ f(\theta) &= \frac{360}{N}\left(\frac{N\theta}{2\pi} - \mathrm{int}\left(\frac{N\theta}{2\pi}\right)\right) \quad \theta(\mathrm{rd}) \end{aligned}$$

Jorge Picado provides a derivation of these equations; it is very comprehensive and beautifully illustrated: http://www.mat.uc.pt/ picado/conchas/index.html Jorge Picado introduces the parameter $D = \pm 1$, thereby allowing for the representation of both sinistral (left-handed) and dextral (right-handed) shells. Jorge Picado offers Mathematica code—which I have not been able to test myself—though the images illustrating his page, accompanied by parameters for a wide range of shells, are highly illustrative. On the American Mathematical Society website, Tony Phillips and Stony Brook also discuss the modeling of various shells, providing code for implementation in Maple: http://www.ams.org/samplings/feature-column/fcarc-shell1

2 The `pst-shell` package

The `pst-shell` package enables the rendering of shells using PSTricks; it is essentially an adaptation of the equations established by M. B. Cortie. [2] The parameters used are identical to those found in the documents by M. B. Cortie and Jorge Picado, so one should refer to these two authors for their definitions. While PSTricks may not offer the rendering speed of Mathematica or Maple, nor the surface smoothing quality achievable with those programs or POV-Ray, it does allow for customized representations—thanks to the options in `pst-solides3d`—that I suspect would be far more difficult to create in Maple or Mathematica; t his point will be explored further using the Nautilus as a case study in a separate file. Here is the list of these parameters; I am providing the default values, which are those of *Natica stellata*, Orange Moon (see Jorge Picado):

- D = 1 : A=25
- alpha=83 : beta=42 : mu=10 : Omega=30 : en degrés
- a=12 : b=20
- L=1
- P=1
- W1=1 : W2=1
- N=0

3 Syntax

\psShell [Options] (x_0, y_0, z_0)

x_0, y_0, z_0 is preset to $0, 0, 0$.

4 Predefined styles

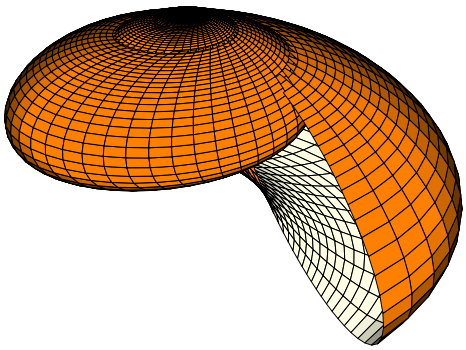
The settings of the predifined styles

```
\newpsstyle[pst-shell]{Achatina}{D=1,A=109,alpha=86.6,beta=8.5,mu=0,Omega=0,phi=0,a=32,b=48,L=0,P=0,W1=1,W2=1,N=0}
\newpsstyle[pst-shell]{Ammonite}{alpha=83,beta=90,phi=1,mu=1,Omega=1,A=2.5,a=1,b=0.9,L=0.5,W1=100,W2=20,P=10,N=15}
\newpsstyle[pst-shell]{Argonauta}{alpha=80,beta=90,phi=0,mu=0,Omega=0,A=2,a=2,b=1.5,L=0.3,W1=150,W2=20,P=5,N=30}%
\newpsstyle[pst-shell]{Codakia}{alpha=37,beta=90,phi=0,mu=1,Omega=1,A=10500,a=10000,b=10500,L=0,W1=0,W2=0,P=0,N=0}
\newpsstyle[pst-shell]{Conus}{D=1,A=7,alpha=87,beta=7,mu=0,Omega=0,phi=78,a=4.3,b=1,L=0,P=0,W1=0,W2=0,N=0}
\newpsstyle[pst-shell]{Epiteonium}{D=1,A=9.5,alpha=85.9,beta=9,mu=0,Omega=0,phi=81,a=2.1,b=1.6,L=1.3,P=-60,W1=200,W2=20,N=8.3}
\newpsstyle[pst-shell]{Escalaria}{alpha=86,beta=10,phi=45,mu=5,Omega=1,A=90,a=20,b=20,L=14,W1=180,W2=0.4,P=40,N=180}
\newpsstyle[pst-shell]{Helcion}{alpha=18,beta=90,phi=0,mu=0,Omega=-40,A=450,a=400,b=310,L=0,W1=0,W2=0,P=0,N=0}
\newpsstyle[pst-shell]{Lyria}{D=1,A=50,alpha=83.9,beta=-19,mu=1,Omega=-2,phi=45,a=40,b=14,L=4,P=0,W1=6,W2=27,N=8}
\newpsstyle[pst-shell]{Natalina}{alpha=80,beta=40,phi=55,mu=10,Omega=30,A=25,a=12,b=16,L=0,W1=0,W2=0,P=0,N=0}
\newpsstyle[pst-shell]{Nautilus}{D=-1,A=2,alpha=80,beta=90,mu=0,Omega=0,phi=0,a=2,b=1.5,L=0,P=0,W1=0,W2=0,N=0}
\newpsstyle[pst-shell]{Oxystele}{D=1,A=47,alpha=84.9,beta=7,mu=0,Omega=0,phi=-36,a=40,b=19,L=0,P=0,W1=1,W2=1,N=0}
\newpsstyle[pst-shell]{Planorbis}{alpha=84,beta=85,phi=10,mu=45,Omega=5,A=45,a=20,b=30,L=0,W1=0,W2=0,P=0,N=0}
\newpsstyle[pst-shell]{Tonna}{D=1,A=70,alpha=82.4,beta=0,mu=10,Omega=0,phi=0,a=58,b=50,L=0,P=0,W1=1,W2=1,N=0}
\newpsstyle[pst-shell]{Turritella}{D=1,A=22.2,alpha=88.9,beta=4,mu=1,Omega=-2,phi=55,a=1.3,b=1.5,L=0,P=0,W1=0,W2=0,N=0}
```

Natica stellata, Orange Moon with basic parameters.

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

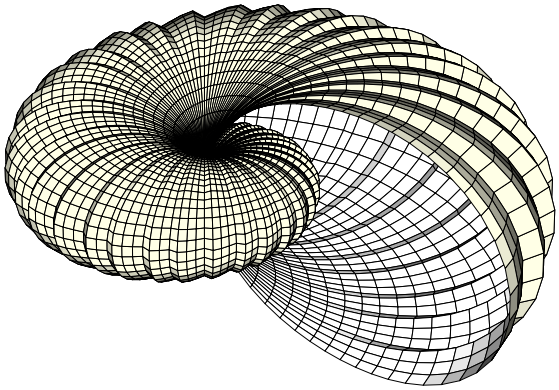
```
\psset[pst-solides3d]{viewpoint=1000 -50 20 rtp2xyz,lightsrc=viewpoint, Screen=25}
\begin{pspicture}(-3,-5)(4,1)
\psShell[ngrid=180 60,fillcolor=orange,incolor=yellow!10,base=720 -720 -270 90,linewidth=0.01pt]
\end{pspicture}
```



Argonauta

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

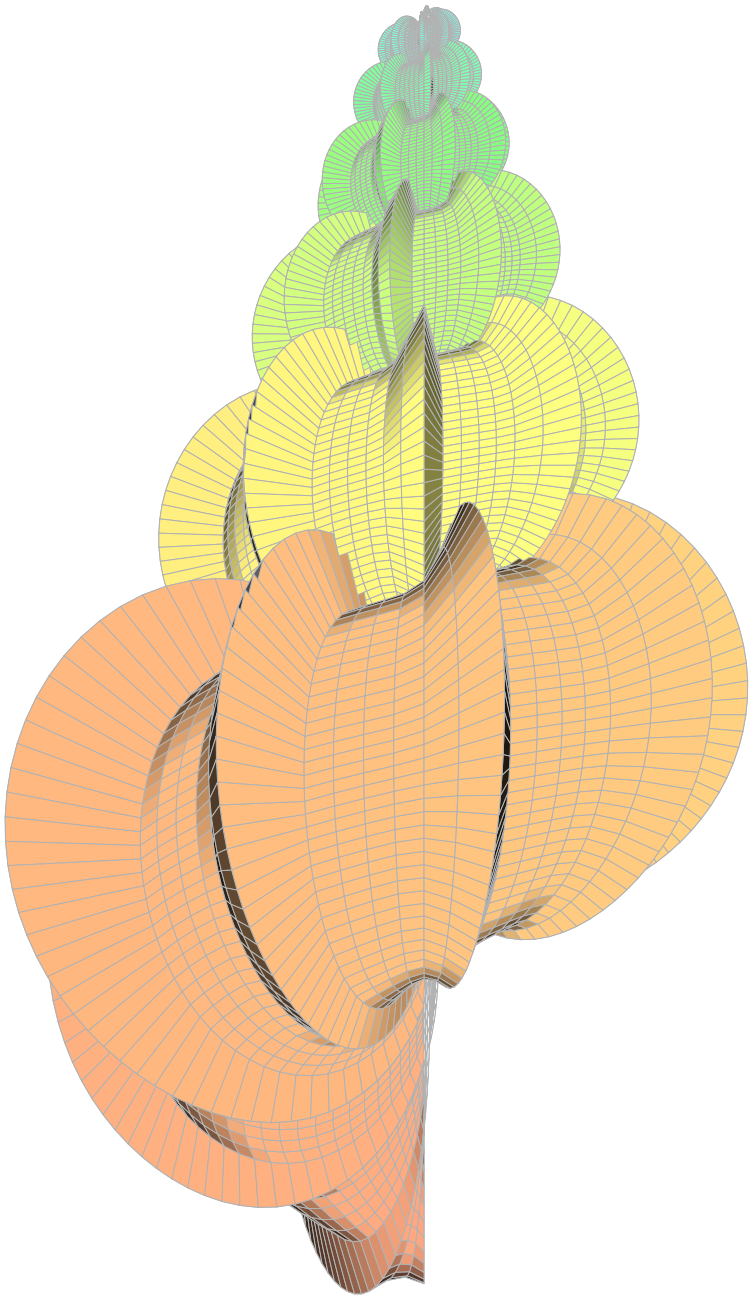
```
\begin{pspicture}(-5,-3)(5,3)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=100 -50 30 rtp2xyz,Screen=120}%
\psShell[style=Argonauta,ngrid=1080 45,incolor=white,
       fillcolor=yellow!10,linewidth=0.01,base=0 -3600 -180 180]
\end{pspicture}
```



Epiteonium

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

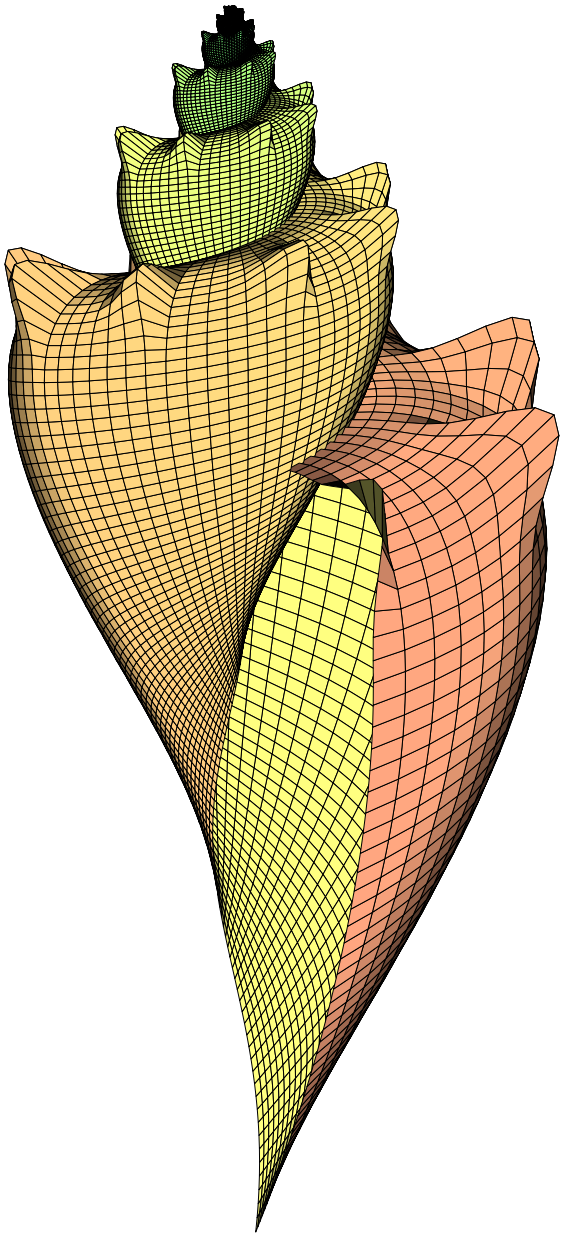
```
\begin{pspicture}(-5,-12)(5,0)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=5000 -180 -10 rtp2xyz,Screen=800}
\psShell[style=Epiteonium,ngrid=360 60,incolor=white,linecolor=black!30,
       base=1800 -360 -270 20,hue=0.05 0.5 0.5 1,linewidth=0.001pt]
\end{pspicture}
```



Lyria

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

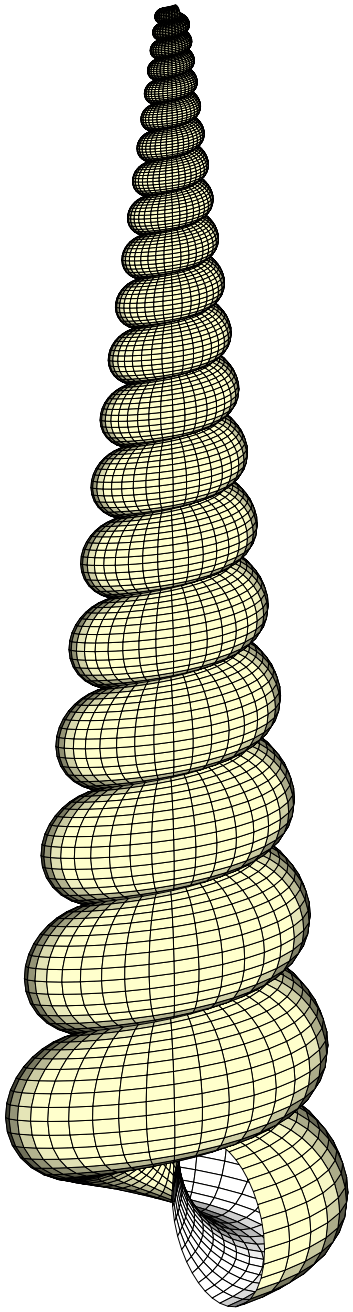
```
\psset{unit=1.2cm}
\begin{pspicture}(-3,-7)(3,0)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=10000 -20 10 rtp2xyz,Screen=100}
\psShell[style=Lyria,base=1800 -360 -51 9,ngrid=360 60,incolor=yellow!50,hue=0.05 0.5 0.5 1,linewidth=0.001pt]
\end{pspicture}
```



Turritella

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

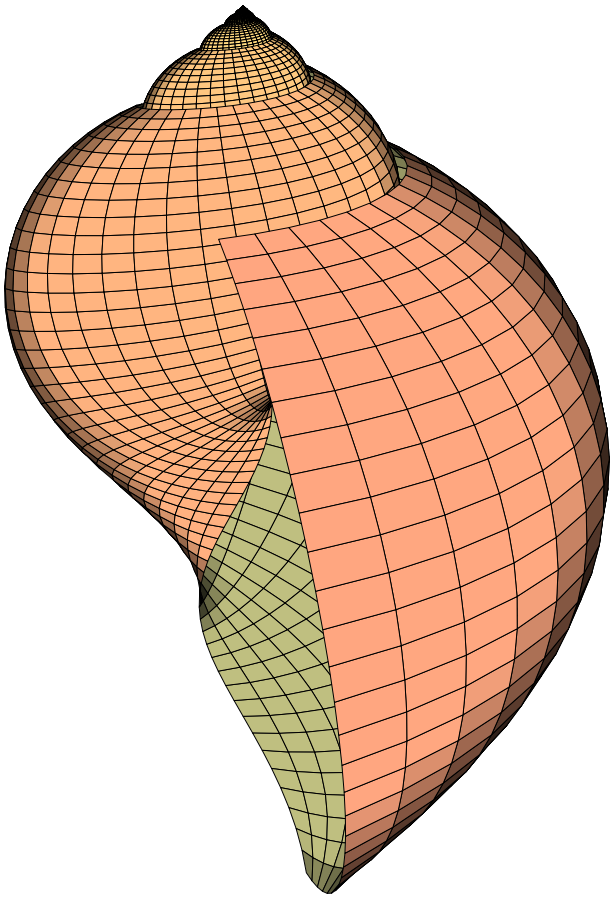
```
\begin{pspicture}(-3,-18)(3,-1)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=1000 -30 10 rtp2xyz,Screen=800}
\psShell[style=Turritella,base=0 -7200 -267 39,ngrid=720 30,incolor=white,
  fillcolor=yellow!20,linewidth=0.01pt]
\end{pspicture}
```



Tonna

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

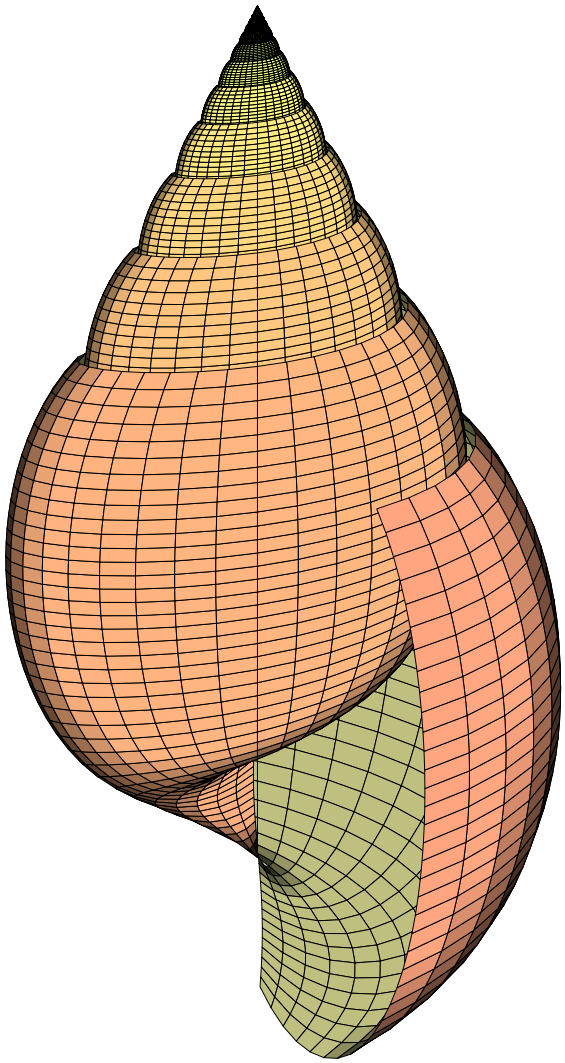
```
\begin{pspicture}(-5,-9)(5,1)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=1000 -10 10 rtp2xyz,Screen=100}
\psShell[style=Tonna,base=0 -7200 -90 60,ngrid=720 30,incolor=yellow!50!black!50,
  hue=0.05 0.5 0.5 1,linewidth=0.005]
\end{pspicture}
```



Achatina

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

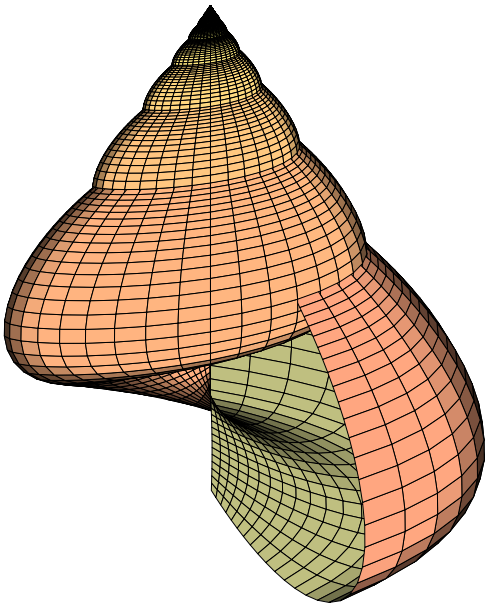
```
\begin{pspicture}(-5,-10)(5,1)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=1000 -30 10 rtp2xyz,Screen=90}
\psShell[style=Achatina,base=0 -7200 -110 65,ngrid=720 36,incolor=yellow!50!black!50,
  hue=0.05 0.5 0.5 1,linewidth=0.005]
\end{pspicture}
```



Oxystele

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

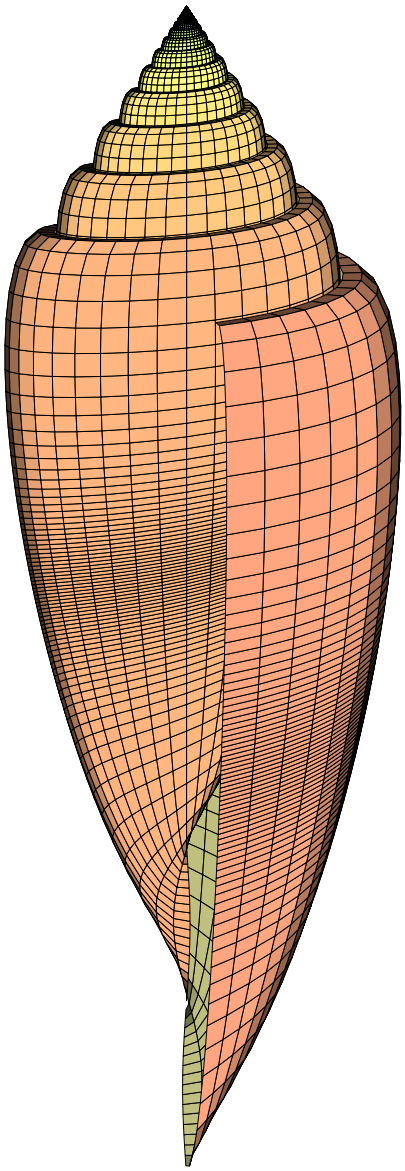
```
\begin{pspicture}(-5,-7)(5,1)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=1000 -30 10 rtp2xyz,Screen=100}
\psShell[style=Oxystele,base=0 -7200 -70 70,ngrid=720 36,incolor=yellow!50!black!50,
  hue=0.05 0.5 0.5 1,linewidth=0.005]
\end{pspicture}
```



Conus

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

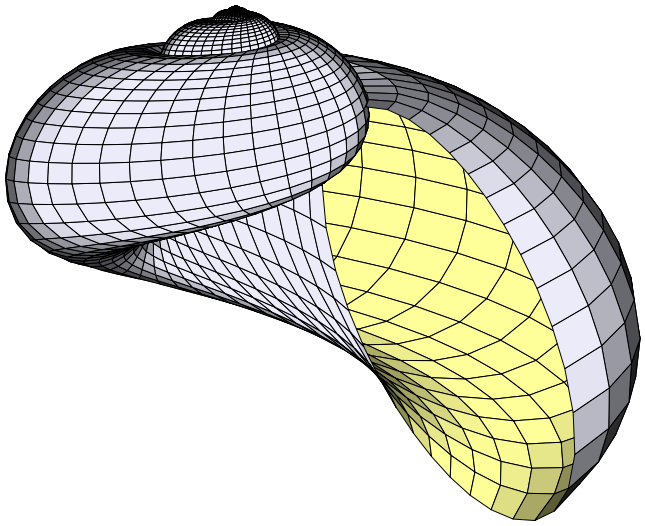
```
\begin{pspicture}(-3,-13)(3,1)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=1000 -10 10 rtp2xyz,Screen=1400}
\psShell[style=Conus,base=0 -7200 -180 2,ngrid=720 72,incolor=yellow!50!black!50,
  hue=0.05 0.5 0.5 1,linewidth=0.005]
\end{pspicture}
```



Natalina

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

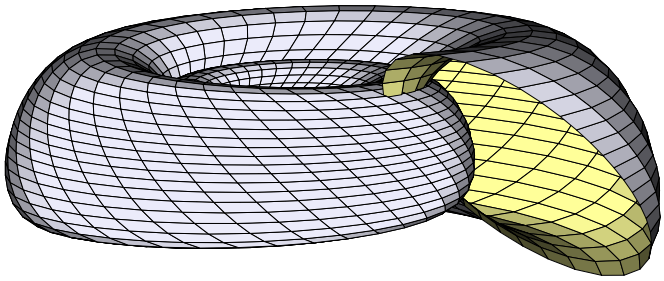
```
\begin{pspicture}(-3,-7)(6,0)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=1000 -60 10 rtp2xyz,Screen=250}
\psShell[style=Natalina,base=0 -7200 -270 62,ngrid=720 30,incolor=yellow!40,
  fillcolor=yellow!20!blue!10,linewidth=0.01pt]
\end{pspicture}
```



Planorbis

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

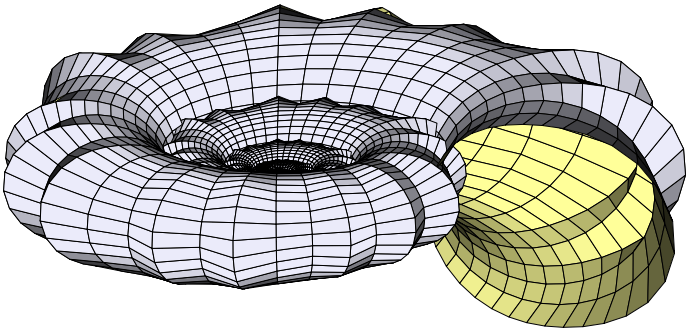
```
\begin{pspicture}[showgrid=false](-4,-3)(6,2)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=1000 -60 10 rtp2xyz,Screen=150}
\psShell[style=Planorbis,base=0 -7200 -150 130,ngrid=720 30,incolor=yellow!40,
 fillcolor=yellow!20!blue!10,linewidth=0.01pt]
\end{pspicture}
```



Ammonite

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

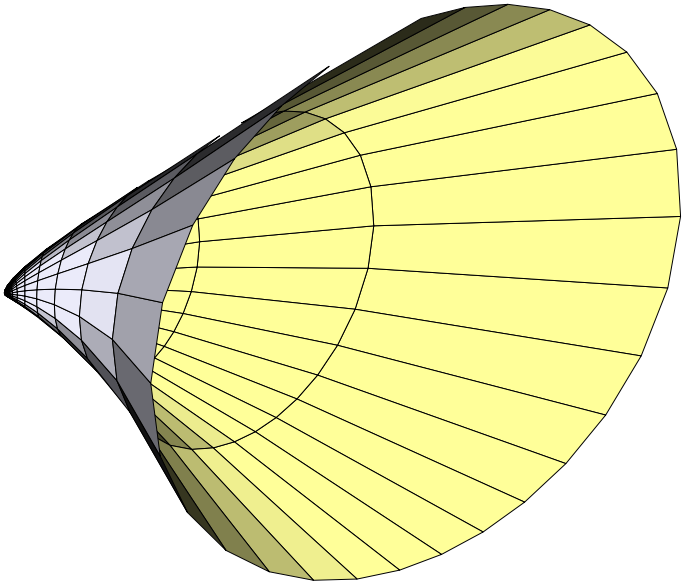
```
\begin{pspicture}[showgrid=false](-4,-2)(6,3)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=100 -60 20 rtp2xyz,Screen=200}
\psShell[style=Ammonite,base=0 -7200 -170 170,ngrid=720 30,incolor=yellow!40,
 fillcolor=yellow!20!blue!10,linewidth=0.01pt]
\end{pspicture}
```



Helcion

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

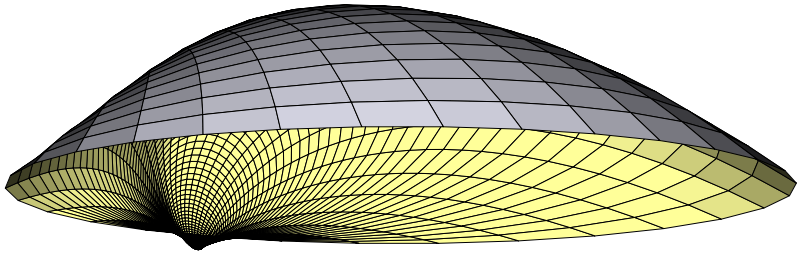
```
\begin{pspicture}[showgrid=false](-1,-4)(10,4)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=4000 -90 20 rtp2xyz,Screen=50}
\psShell[style=Helcion,base=0 -7200 -180 180,ngrid=720 30,incolor=yellow!40,
  fillcolor=yellow!20!blue!10,linewidth=0.01pt]
\end{pspicture}
```



Codakia

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

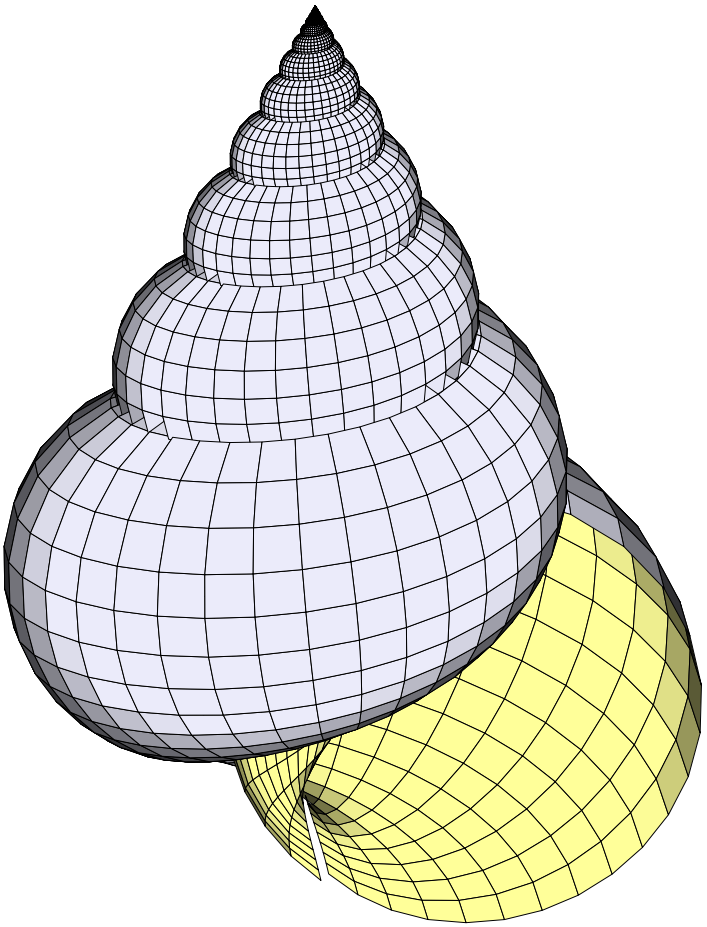
```
\begin{pspicture}[showgrid=false](-3,-1)(8,3)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=1.e6 -30 -10 rtp2xyz,Screen=500}
\psShell[style=Codakia,base=0 -2000 -180 180,ngrid=720 30,incolor=yellow!40,RotX=90,%RotY=90,
 fillcolor=yellow!20!blue!10,linewidth=0.01pt]
\end{pspicture}
```



Escalaria

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

```
\begin{pspicture}[showgrid=false](-3,-7)(3,0)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=800 -90 20 rtp2xyz,Screen=100}
\psShell[style=Escalaria,base=0 -7200 -180 180,ngrid=720 30,incolor=yellow!40,
  fillcolor=yellow!20!blue!10,linewidth=0.01pt]
\end{pspicture}
```

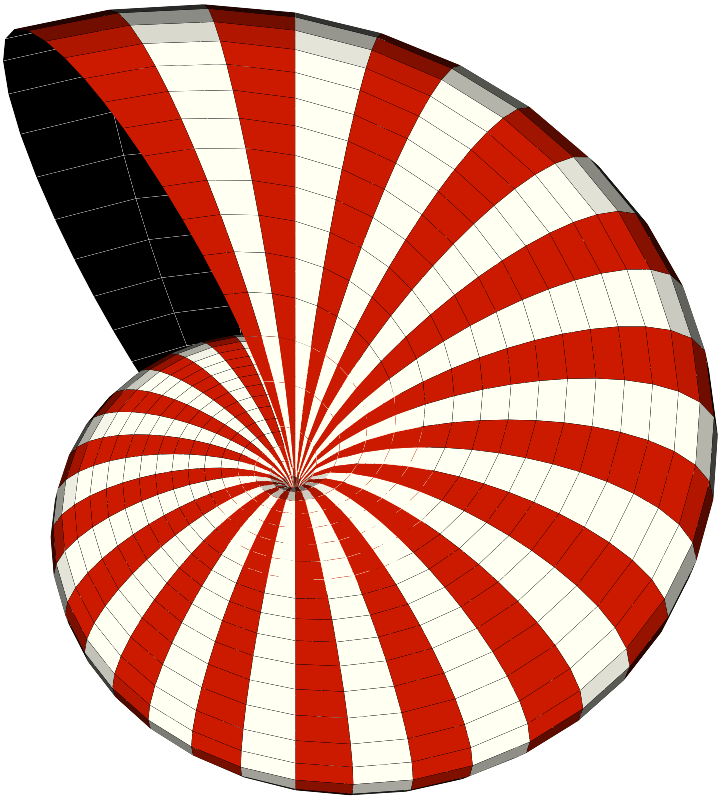


5 The colorful patterns adorning seashells

Hans Meinhardt developed the activator-inhibitor reaction-diffusion equations that allow for the simulation of the colorful patterns found on a wide variety of seashells. [4] His book, »The Algorithmic Beauty of Seashells«, contains all the equations, photographs of the shells, and a CD with a simulation program. Naturally, this is the most challenging part—not so much generating the patterns themselves, but applying them to the specific shape of the corresponding shell. Randolf Schultz successfully combined these two elements—shell geometry and patterns in his program. [6] It is shareware; the program can be used without purchasing it, though this prevents you from saving your creations. The following example attempts to approximate the patterns of the *Nautilus*. Other ways of representing the »Nautilus« are explored in the dedicated file.

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

```
\definecolor{beige}{rgb}{0.88 0.8 0.6}
\begin{pspicture}(-3,-3)(4,4)
\psset[pst-solides3d]{lightsrc=viewpoint,viewpoint=50 -30 60 rtp2xyz,Screen=100}
\psShell[style=Nautilus,base=0 -3600 180 -180,ngrid=360 36,unit=1,incolor=beige,
  fillcolor=yellow!5,linewidth=0, fcol=0 72 360 36 2 div mul cvi 36 sub
    { dup 1 exch 36 add { (0.8 0.1 0 setrgbcolor)} for} for]
\end{pspicture}
```



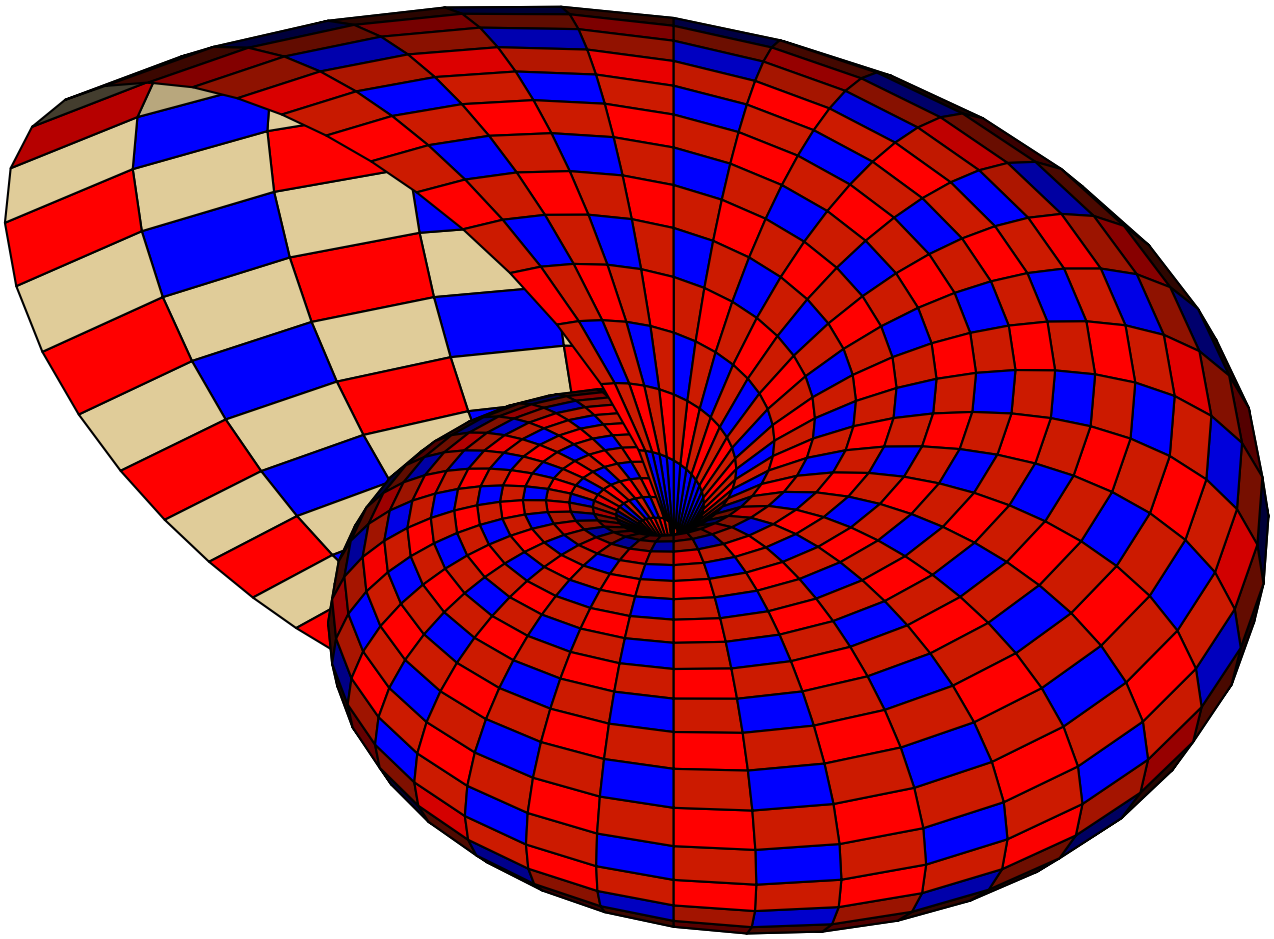
6 Shells created with a data file

`\psShell[filename=data/nautile-360-36,...]`

In order to carry out the desired transformations.

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

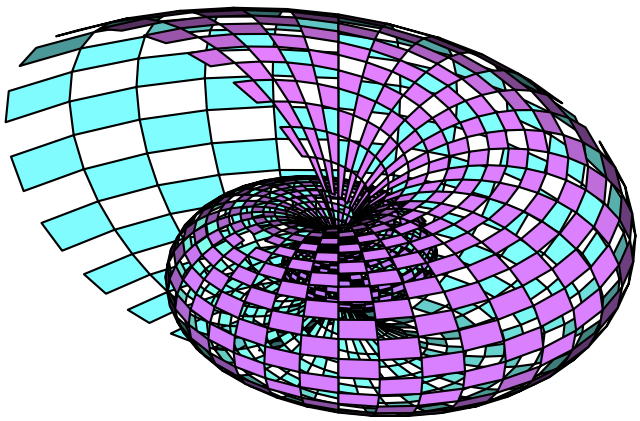
```
\definecolor{beige}{rgb}{0.88 0.8 0.6}
\psset{unit=1.5}
\begin{pspicture}(-3.5,-2)(3.5,3)
\psset{lightsrc=viewpoint,viewpoint=50 -50 40 rtp2xyz,Screen=100,solidmemory}
\psShell[filename=data/nautile-360-36,incolor=white,fcol= 0 72 360 71 mul { dup 2 exch 36 add
         { dup (rouge) exch 37 add (blue)} for} for]
\end{pspicture}
```



For the second drawing, we will create openings in the shell by removing every other facet. The `rm=`⟨*numbers of faces to remove*⟩ keyword in `pst-solides3d` ought to handle this, but having encountered some issues with it, I remove the facets directly using a PostScript macro; the file is then saved so it can be reused without recalculating.

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

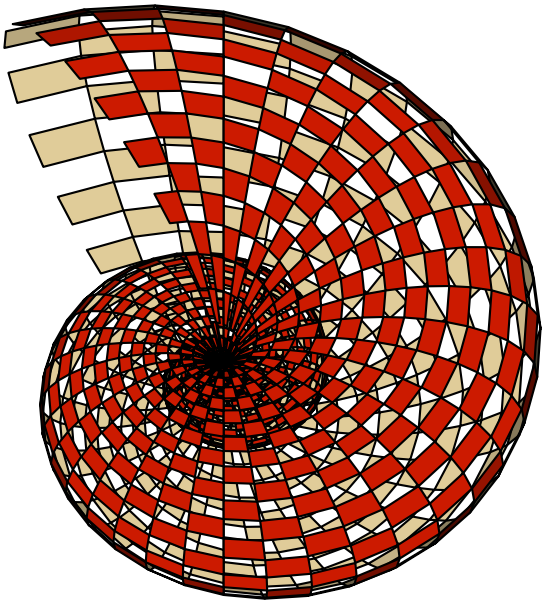
```
\psset{unit=1.5}
\begin{pspicture}(-4,-2)(3,3)
\psset{lightsrc=viewpoint,viewpoint=50 -50 30 rtp2xyz,Screen=50,solidmemory}
\psShell[filename=data/testnautile-360-36,deactivatecolor]
\end{pspicture}
```



You delete the facets directly using the rm command, which takes much longer!

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

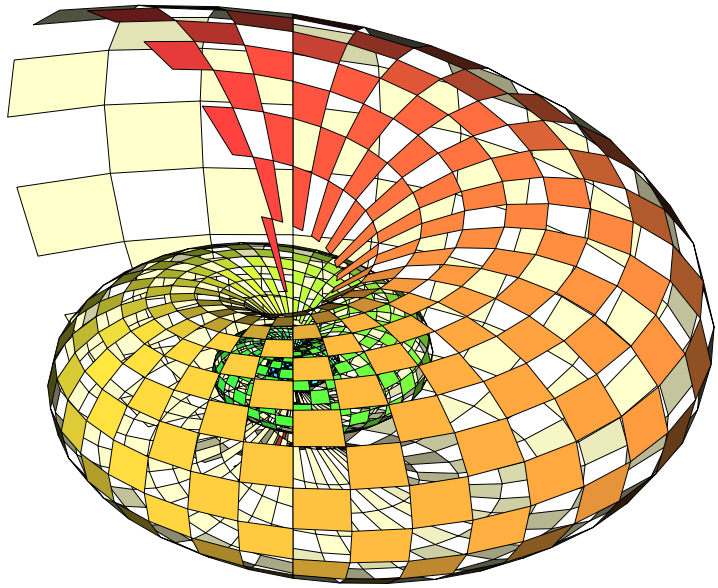
```
\psset{unit=1.5}
\begin{pspicture}(-3,-3)(4,4)
\psset{lightsrc=viewpoint,viewpoint=50 -30 60 rtp2xyz,Screen=50,solidmemory}
\psShell[filename=data/nautile-360-36,deactivatecolor,rm= 0 72 360 71 mul {/i exch def i 2 i 36 add
      {/j exch def j j 37 add} for} for]
\end{pspicture}
```



Change the resolution to 180 × 24 and save the file.

```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

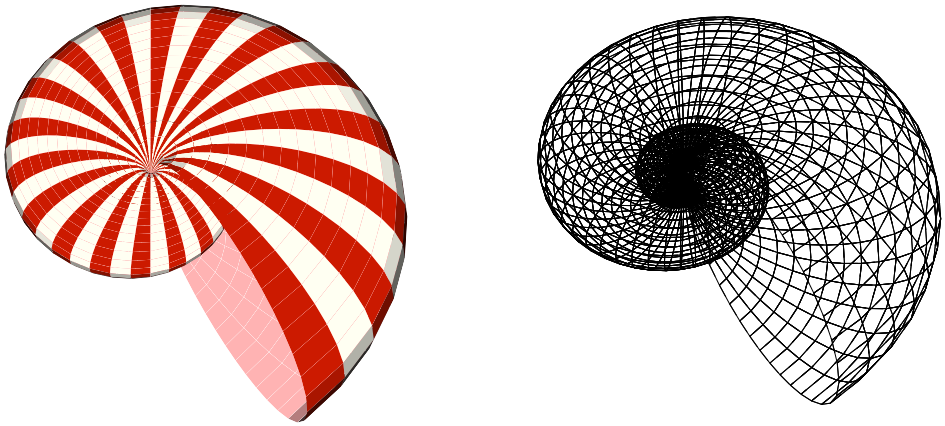
```
\definecolor{beige}{rgb}{0.88 0.8 0.6}
\psset{unit=2cm}
\begin{pspicture}(-3,-2)(4,3)
\psset{lightsrc=viewpoint,viewpoint=50 -30 30 rtp2xyz,Screen=50}
\psShell[filename=data/nautile-180-24,deactivatecolor,linewidth=0.001,
       precode=/n1 180 def /n2 24 def /n1n2 n1 n2 2 mul 1 sub mul def /step n2 2 mul def,
         rm= 0 step n1n2 { dup 2 exch n2 add
            { dup n2 add 1 add} for} for]
\end{pspicture}
```



Other variations for coloring the seashell.

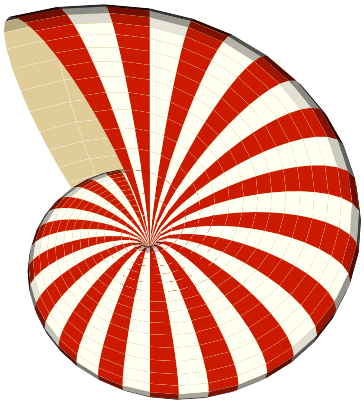
```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

```
\definecolor{beige}{rgb}{0.88 0.8 0.6}
\begin{pspicture}(-3,-4)(4,3)
\psset{lightsrc=viewpoint,viewpoint=50 -30 60 rtp2xyz,Screen=50}
\psShell[style=Nautilus,D=1,base=0 -3600 -180 180,ngrid=360 36,incolor=red!30,
       fillcolor=yellow!5,linewidth=0,
       fcol=0 72 360 36 2 div mul cvi 36 sub { dup 1 exch 36 add
           { (0.8 0.1 0 setrgbcolor) } for } for]
\end{pspicture}
\begin{pspicture}(-3,-4)(4,3)
\psset{viewpoint=100 -30 50 rtp2xyz,Screen=100}
\psShell[style=Nautilus,D=1,base=0 -720 -180 180,ngrid=90 36,linewidth=0.01pt,action=draw]
\end{pspicture}
```



```
\usepackage[dvipsnames,svgnames]{pstricks}
\usepackage{pst-shell}
```

```
\definecolor{beige}{rgb}{0.88 0.8 0.6}
\begin{pspicture}(-3,-3)(4,4)
\psset{lightsrc=viewpoint,viewpoint=50 -30 60 rtp2xyz,Screen=50}
\psShell[style=Nautilus,base=0 -3600 180 -180,ngrid=360 36,incolor=beige,
  fillcolor=yellow!5,linewidth=0,fcol=0 72 360 36 2 div mul cvi 36 sub
    { dup 1 exch 36 add { (0.8 0.1 0 setrgbcolor)} for} for]
\end{pspicture}
\begin{pspicture}(-3,-3)(4,4)
\psset{lightsrc=viewpoint,viewpoint=50 -30 60 rtp2xyz,Screen=50}
\psShell[style=Nautilus,base=0 -3600 180 -180,ngrid=360 36,incolor=beige,
 fillcolor=yellow!5,linewidth=0,fcol=0 2 360 36 2 div mul cvi 2 sub
   { (0.8 0.1 0 setrgbcolor)} for]
\end{pspicture}
```



7 Saving data to external files

With the optional argument `writedata` one can save the data in external files. The shell itself is not plotted.

```
\psShell[writedata,filename=data/myShell,...]
```

Subdirectories must exist, otherwise the package throws an error on PostScript level. The external files are created with either a Ghostscript run `gs <file>.ps` or when converting the file to pdf. The example:

write data file

```
{}
\begin{pspicture}(-4,-4)(4,4)
\psset{lightsrc=viewpoint,viewpoint=10 -20 0 rtp2xyz,Screen=10}
\psset{style=Nautilus,A=0.5,alpha=45,beta=90,a=0.5,b=0.75}
\psShell[writedata,filename=data/cockle,base=0 -3600 -180 200,
   ngrid=360 36,unit=4cm,linewidth=0.001,RotX=-90,incolor=white,fillcolor=white,
   fcol=0 2 360 36 2 div mul cvi 2 sub { (0.8 0.1 0 setrgbcolor)} for
        360 36 mul cvi 2 360 36 mul 2 mul 2 sub { (0 0 0.8 setrgbcolor)} for]
\end{pspicture}
```

creates four files in the subdirectory `data/`:

```
-rw-r--r-- 1 voss staff 272160 14 Juni 13:40 data/cockle-couleurs.dat
-rw-r--r-- 1 voss staff 307140 14 Juni 13:40 data/cockle-faces.dat
-rw-r--r-- 1 voss staff 14 14 Juni 13:40 data/cockle-io.dat
-rw-r--r-- 1 voss staff 347108 14 Juni 13:40 data/cockle-sommets.dat
```

References

[1] Bill Casselman. *Mathematical Illustrations – a manual of geometry and PostScript*. Cambridge: Cambridge University Press, 2005.

[2] Michael Cortie. "Digital seashells". In: *Computers & Graphics* 17 (Feb. 1993), pp. 79–84. DOI: 10.1016/0097-8493(93)90054-D. URL: https://www.researchgate.net/publication/223141547_Digital_seashells (visited on 06/12/2026).

[3] Michel Goosens et al. *The LaTeX Graphics Companion*. 2nd. Reading, Mass.: Addison-Wesley Publishing Company, 2007.

[4] Hans Meinhardt. *The Algorithmic Beauty of Sea Shells*. 4th ed. The Virtual Laboratory. Berlin and Heidelberg: Springer Verlag, Aug. 27, 2009, pp. XIV, 269. ISBN: 978-3-540-92141-7. DOI: https://doi.org/10.1007/978-3-540-92142-4.

[5] Jorge Picado. *SEASHELLS: THE PLAINNESS AND BEAUTY OF THEIR MATHEMATICAL DESCRIPTION*. URL: http://www.mat.uc.pt/~picado/conchas/eng/article.pdf (visited on 06/12/2026).

[6] Randolf Schultz. *Shelly lib*. July 8, 2008. URL: http://www.shelly.de (visited on 06/14/2026).

[7] Herbert Voß. *PSTricks – Grafik für TeX und LaTeX*. 7. Heidelberg/Berlin: DANTE – Lehmanns, 2016.

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