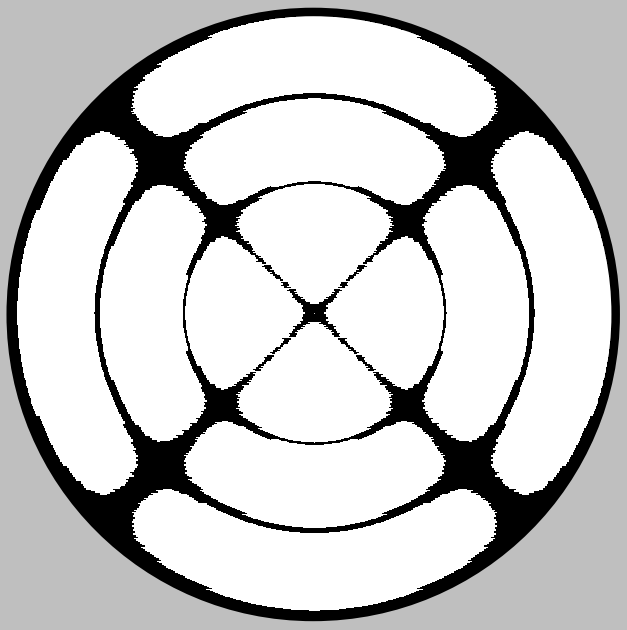
PSTricks

pst-chladni

v.0.01

Chladni acoustic patterns for a circular membrane

June 13, 2026



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Contents

1 introduction

Theoretical background can be found in [4, 3, 1, 2]. Ernst Florens Friedrich Chladni (30 November 1756 – 3 April 1827) was a German physicist and musician. His most important work, for which he is sometimes labeled the father of acoustics, included research on vibrating plates and the calculation of the speed of sound for different gases. [4]

2 The macros

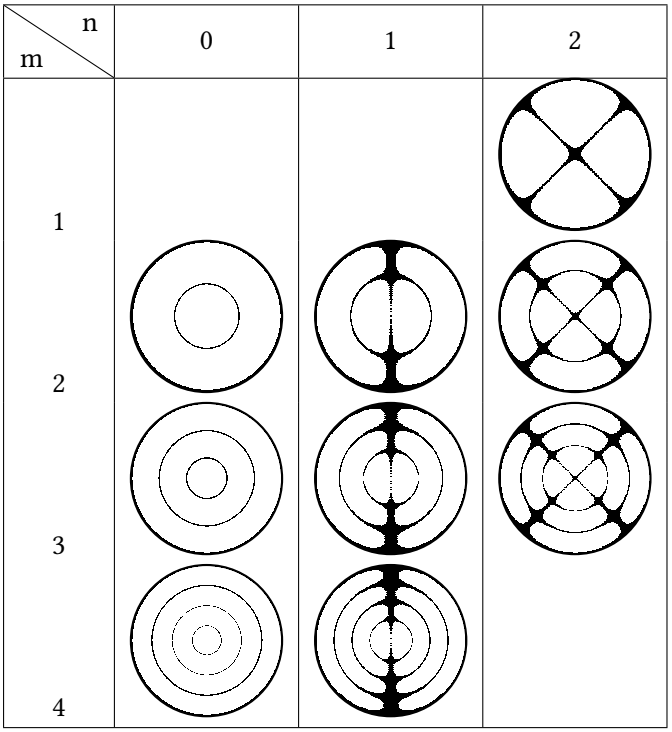
There are two PStricks commands, involving very few options:

```
\psNodalLinesCircularPlane [Options]
\psCircularMembrane [Options]
\psNodalCircular(n,m)
```

The macros allow for plotting the nodal lines in the plane by simulating the distribution of sand grains, and for visualizing the 3D deformation of the plate at a given moment. `R=1` is the radius of the membrane, `coeffZ=1` is a scaling factor along the z-axis, `n=1` (default is 0) and `m=1` (default is 1) represent the vibration modes, and `date=seconds` allows the plate to be viewed in 3D at a specific time.

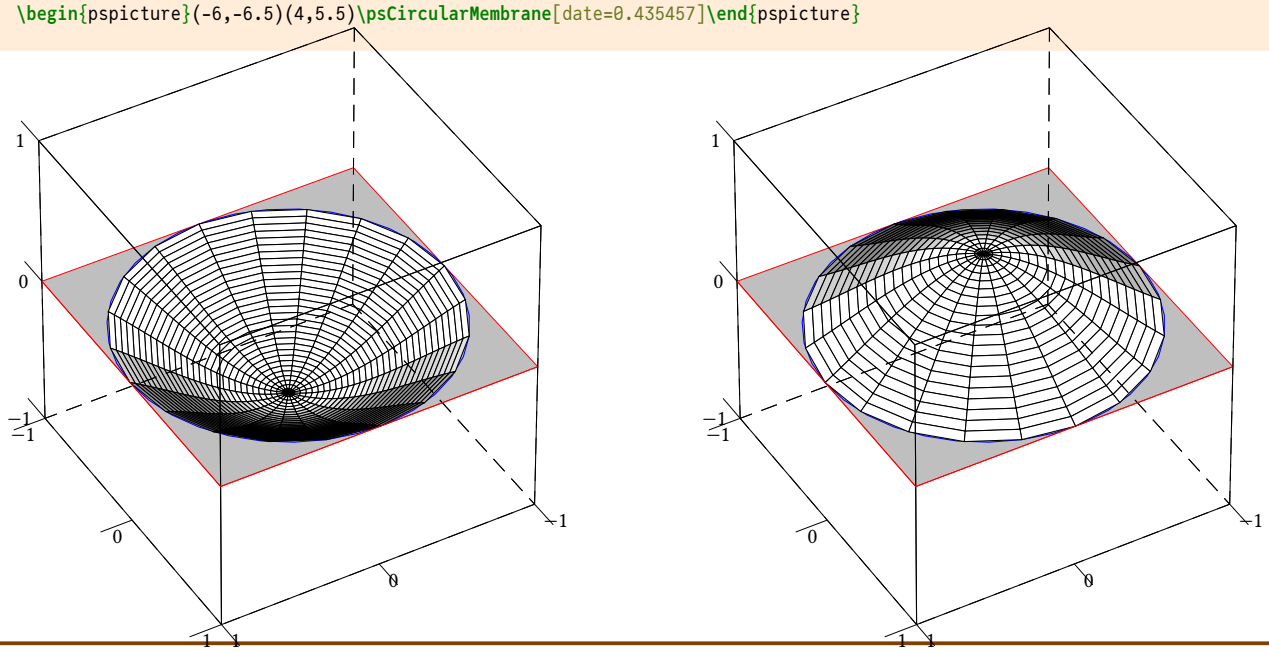
In addition to the PStricks command, there is also Maple code for drawing the 3D figure, which will allow you to compare the figures if you wish.

`\psNodalCircular{`n,m`}` (m=row, n=column)



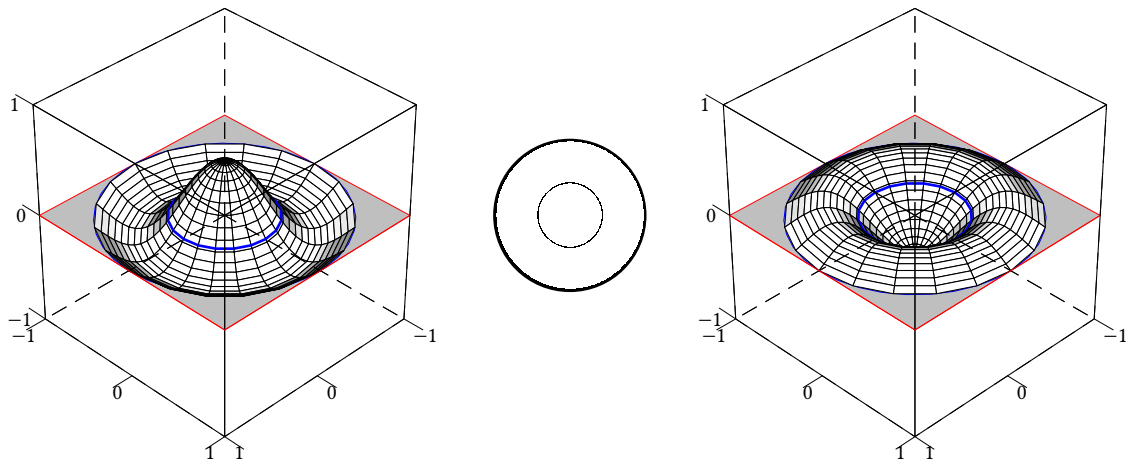
The default output for

```
\psset{viewpoint=50 60 40 rtp2xyz,Decran=200,lightsrc=viewpoint,showAxes=false,unit=0.6}
\begin{pspicture}(-6,-6.5)(4,5.5)\psCircularMembrane[date=0.8709,ngrid=0.2 0.2]\end{pspicture}
\hspace{3cm}
\begin{pspicture}(-6,-6.5)(4,5.5)\psCircularMembrane[date=0.435457]\end{pspicture}
```



n=0,m=2

```
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=0,m=2,coeffZ=0.5]\end{pspicture}
\begin{pspicture}(-0.5,-3.25)(0.5,2.75)\psNodalLinesCircularPlane[n=0,m=2]\end{pspicture}
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=0,m=2,date=0.435457,coeffZ=0.5]\end{pspicture}
```

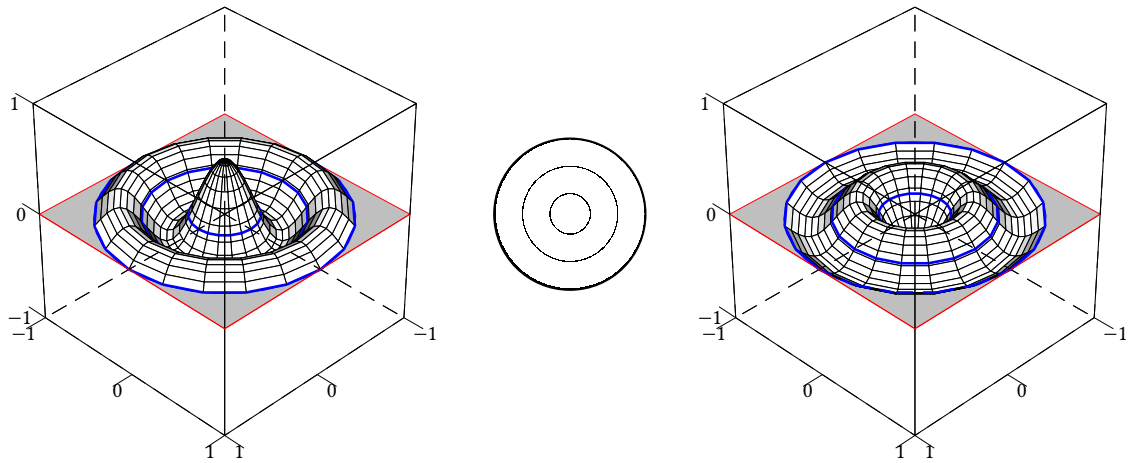


Maple code for (0,2)

```
> alpha2:=BesselJZeros(0,2);
> v:=(r,t)->BesselJ(0,alpha2*r)*cos(alpha2*t);
> plot3d([r,theta,v(r,0)],r=0..1,theta=-Pi..Pi,coords=cylindrical,axes=frame);
```

n=0,m=3

```
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=0,m=3,coeffZ=0.5]\end{pspicture}
\begin{pspicture}(-0.5,-3.25)(0.5,2.75)\psNodalLinesCircularPlane[n=0,m=3]\end{pspicture}
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=0,m=3,date=0.435457,coeffZ=0.5]\end{pspicture}
```

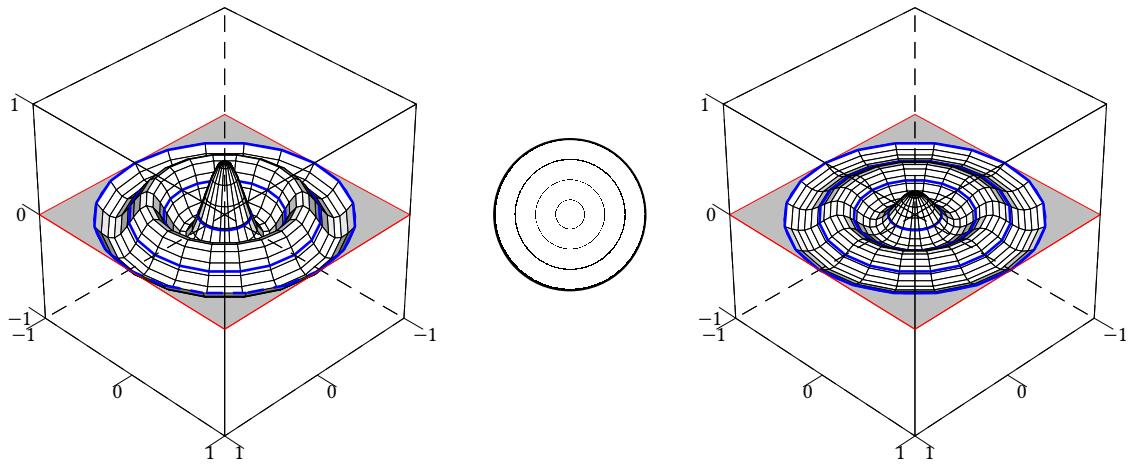


Maple code for (0,3)

```
> alpha3:=BesselJZeros(0,3);
> v:=(r,t)->BesselJ(0,alpha3*r)*cos(alpha3*t);
> plot3d([r,theta,v(r,0)],r=0..1,theta=-Pi..Pi,coords=cylindrical,axes=frame);
```

n=0,m=4

```
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=0,m=4,coeffZ=0.5]\end{pspicture}
\begin{pspicture}(-0.5,-3.25)(0.5,2.75)\psNodalLinesCircularPlane[n=0,m=4]\end{pspicture}
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=0,m=4,date=0.435457,coeffZ=0.5]\end{pspicture}
```

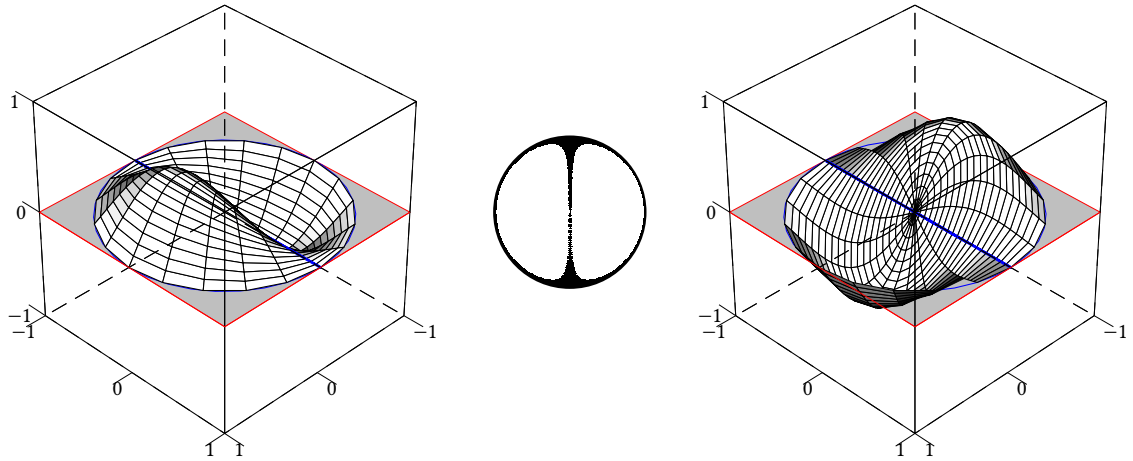


Maple code for (0,4)

```
> alpha4:=BesselJZeros(0,4);
> v:=(r,t)->BesselJ(0,alpha4*r)*cos(alpha4*t);
> plot3d([r,theta,v(r,0)],r=0..1,theta=-Pi..Pi,coords=cylindrical,axes=frame);
```

n=1,m=1

```
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=1,m=1]\end{pspicture}
\begin{pspicture}(-0.5,-3.25)(0.5,2.75)\psNodalLinesCircularPlane[n=1,m=1]\end{pspicture}
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=1,m=1,date=0.82]\end{pspicture}
```

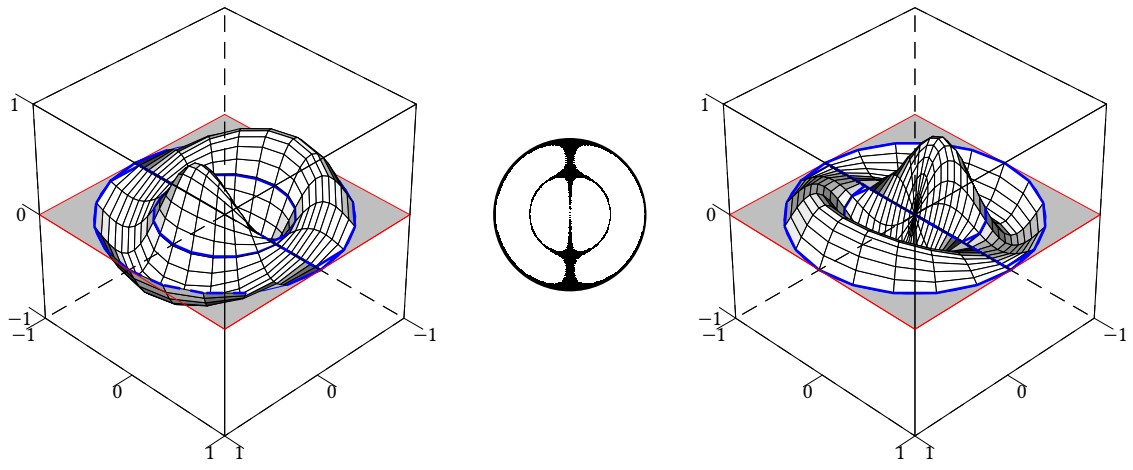


Maple code for (1,1)

```
1 > alpha[1,1]:=BesselJZeros(1,1);
2 > u:=(r,theta,t)->BesselJ(1,alpha[1,1]*r)*cos(theta)*cos(alpha[1,1]*t);
3 > plot3d([r,theta,u(r,theta,0)],r=0..1,theta=-Pi..Pi,coords=cylindrical,axes=frame);
```

n=1,m=2

```
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=1,m=2]\end{pspicture}
\begin{pspicture}(-0.5,-3.25)(0.5,2.75)\psNodalLinesCircularPlane[n=1,m=2]\end{pspicture}
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=1,m=2,date=0.448]\end{pspicture}
```

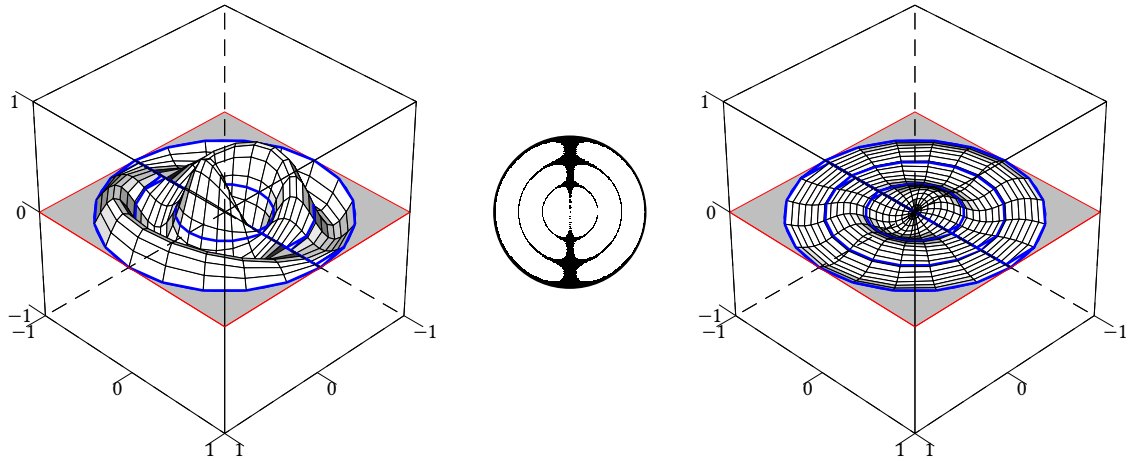


Maple code for (1,2)

```
1 > alpha[1,2]:=BesselJZeros(1,2);
2 > u:=(r,theta,t)->BesselJ(1,alpha[1,2]*r)*cos(theta)*cos(alpha[1,2]*t);
3 > plot3d([r,theta,u(r,theta,0)],r=0..1,theta=-Pi..Pi,coords=cylindrical,axes=frame);
```

n=1,m=3

```
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=1,m=3]\end{pspicture}
\begin{pspicture}(-0.5,-3.25)(0.5,2.75)\psNodalLinesCircularPlane[n=1,m=3]\end{pspicture}
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=1,m=3,date=0.448]\end{pspicture}
```

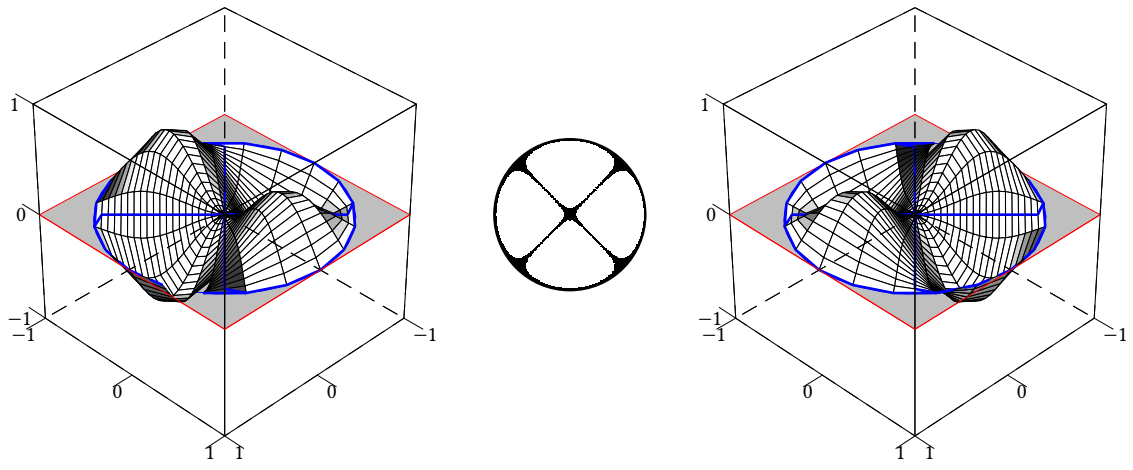


Maple code for (1,3)

```
1 > alpha[1,3]:=BesselJZeros(1,3);
2 > u:=(r,theta,t)->BesselJ(1,alpha[1,3]*r)*cos(theta)*cos(alpha[1,3]*t);
3 > plot3d([r,theta,u(r,theta,0)],r=0..1,theta=-Pi..Pi,coords=cylindrical,axes=frame);
```

n=2,m=1

```
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=2,m=1,,date=0.617]\end{pspicture}
\begin{pspicture}(-0.5,-3.25)(0.5,2.75)\psNodalLinesCircularPlane[n=2,m=1]\end{pspicture}
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=2,m=1]\end{pspicture}
```

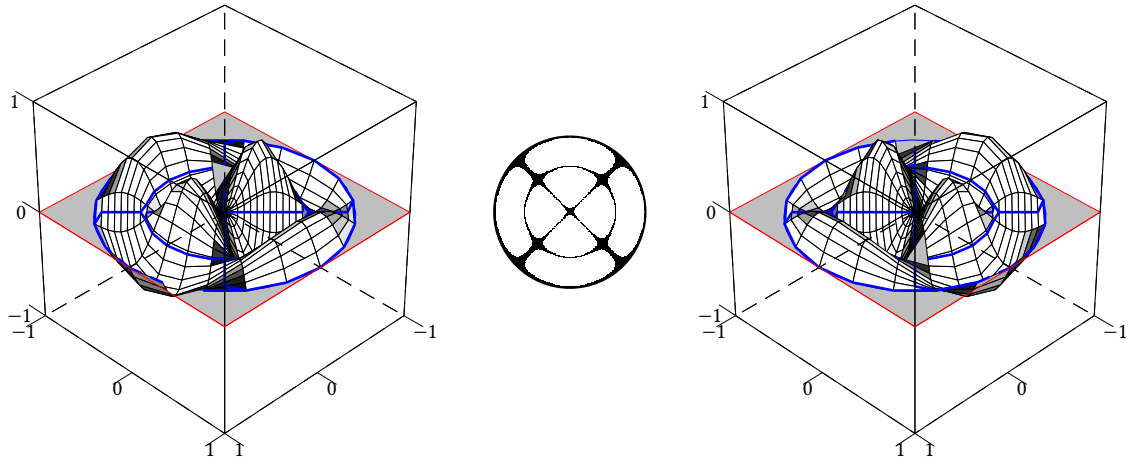


Maple code for (2,1)

```
1 > alpha[2,1]:=BesselJZeros(2,1);
2 > u:=(r,theta,t)->BesselJ(2,alpha[2,1]*r)*cos(2*theta)*cos(alpha[2,2]*t);
3 > plot3d([r,theta,u(r,theta,0)],r=0..1,theta=-Pi..Pi,coords=cylindrical,axes=frame);
```

n=2,m=2

```
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=2,m=2]\end{pspicture}
\begin{pspicture}(-0.5,-3.25)(0.5,2.75)\psNodalLinesCircularPlane[n=2,m=2]\end{pspicture}
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=2,m=2,date=0.372]\end{pspicture}
```

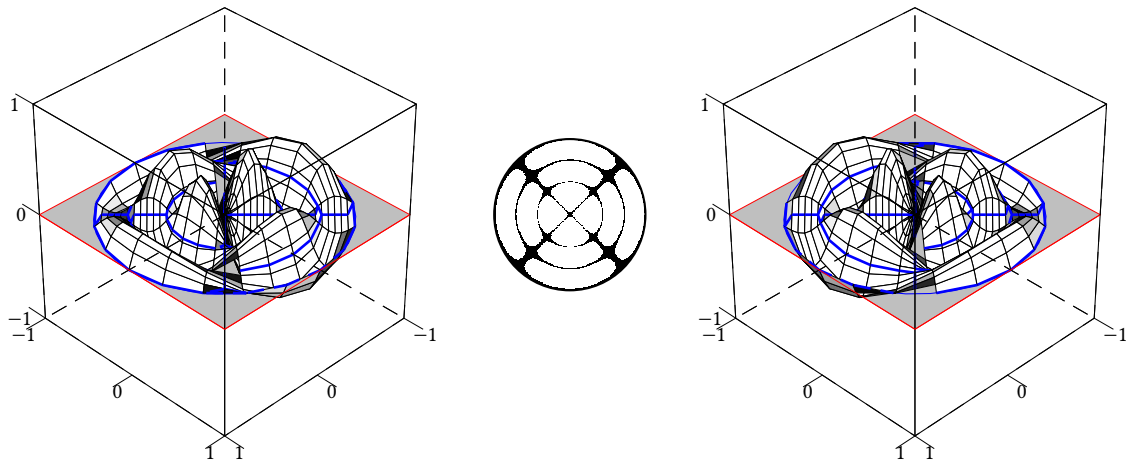


Maple code for (2,2)

```
> alpha[2,2]:=BesselJZeros(2,2);
> u:=(r,theta,t)->BesselJ(2,alpha[2,2]*r)*cos(2*theta)*cos(alpha[2,2]*t);
> plot3d([r,theta,u(r,theta,0)],r=0..1,theta=-Pi..Pi,coords=cylindrical,axes=frame);
```

n=2,m=3

```
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=2,m=3]\end{pspicture}
\begin{pspicture}(-0.5,-3.25)(0.5,2.75)\psNodalLinesCircularPlane[n=2,m=3]\end{pspicture}
\begin{pspicture}(-4,-3.25)(4,2.75)\psset{unit=0.6}\psCircularMembrane[n=2,m=3,date=0.270365]\end{pspicture}
```



Maple code for (2,3)

```
> alpha[2,3]:=BesselJZeros(2,3);
> u:=(r,theta,t)->BesselJ(2,alpha[2,3]*r)*cos(2*theta)*cos(alpha[2,3]*t);
> plot3d([r,theta,u(r,theta,0)],r=0..1,theta=-Pi..Pi,coords=cylindrical,axes=frame);
```

References

[1] The Experimental Nonlinear Physics Group, ed. *Chladni patterns in vibrated plates*. URL: https://www.physics.utoronto.ca/nonlinear/chladni.html (visited on 06/12/2026).

[2] Derek Kverno and Jim Nolen. *A Study of Vibrating Plates*. URL: https://web.archive.org/web/20190922231130/https://www.phy.davidson.edu/StuHome/derekk/Chladni/pages/menu.htm (visited on 06/12/2026).

[3] Derek Kverno and Jim Nolen. "Chladni patterns in vibrated plates". In: (). URL: https://pearl-hifi.com/06_Lit_Archive/07_Misc_Downloads/135_Chladni_Patterns_in_Vibrated_Plates.pdf (visited on 06/12/2026).

[4] WIKIPEDIA. *Chladni's law*. URL: https://en.wikipedia.org/wiki/Chladni%27s_law (visited on 06/12/2026).

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