

```

In[ ]:= Manipulate[
  Module[{xx, yy,
    opt = {PerformanceGoal -> "Quality", ImageMargins -> 1}, r, r0, c0, a00, b00, color0},
    c0 = Sqrt[tension * 1000 / (rho * 10^6)];
    a00 = a0 / 1000; (*mm to meter*)
    b00 = b0 / 1000;
    r = w[x, y, a00, b00, m0, n0, c0, t, t0]; (*saved for tooltip to show analytical form*)
    r0 = r /. {t -> t0, x -> xx, y -> yy}; (*used for plotting*)
    Which[
      color == 1, color0 = Automatic,
      color == 2, color0 = (ColorData["TemperatureMap"])[#3] &),
      color == 3, color0 = Function[{x, y, z}, Hue[z]],
      color == 4, color0 = "BlueGreenYellow",
      color == 5, color0 = "Rainbow",
      color == 6, color0 = Function[{x, y}, ColorData["NeonColors"][y]]
    ];

  Grid[{
    {plotType == "contour",

      ContourPlot[Evaluate@r0, {xx, 0, a00}, {yy, 0, b00},
        Evaluate@opt,
        ImageSize -> {350, 436},
        FrameLabel -> {{y, None}, {x, None}},
        ColorFunction -> "Pastel",
        ImagePadding -> 30,
        FrameTicksStyle -> 8,
        Contours -> contoursLines],
      SpanFromLeft}
    ], Alignment -> Center, Spacings -> 0
  ]
],
Text@Grid[{
  {
    Style[TraditionalForm[Defer[D[u[x, y, t], {x, 2}] + D[u[x, y, t], {y, 2}]] ==
      Defer[HoldForm[1 / c^2] D[u[x, y, t], {t, 2}]]], 14], SpanFromLeft
  },
  {
    Grid[{
      {
        Row[{Style[TraditionalForm[HoldForm[ $\lambda = c \pi \sqrt{\frac{m^2}{a^2} + \frac{n^2}{b^2}}$ ]], 14], Spacer[3], "(hz)"}]
      }
    ], Alignment -> Center, Spacings -> {.1, .1}
  ]
}],

```

```

{Grid[{
  {
    Grid[{
      {
        Style["T", Italic, 12],
        Manipulator[Dynamic[tension, {tension = #} &], {0.1, 10, 0.1}, ImageSize →
          Small, ContinuousAction → True], Dynamic[padIt2[tension, {3, 1}]], "N/mm"
      },
      {
        Style[ $\rho$ , Italic, 12],
        Manipulator[Dynamic[ $\rho$ 0, { $\rho$ 0 = #} &], {0.1, 2, 0.1}, ImageSize → Small,
          ContinuousAction → True], Dynamic[padIt2[ $\rho$ 0, {2, 1}]], "kg/mm2"
      },
      {
        Style["a", Italic, 12],
        Manipulator[Dynamic[a0, {a0 = #} &], {10, 1000, 1},
          ImageSize → Small, ContinuousAction → True], Dynamic[padIt2[a0, 4]], "mm"
      },
      {
        Style["b", Italic, 12],
        Manipulator[Dynamic[b0, {b0 = #} &], {10, 1000, 1},
          ImageSize → Small, ContinuousAction → True], Dynamic[padIt2[b0, 4]], "mm"
      }
    ], Spacings → {.4, 0}, Alignment → Left
  ]
}, Spacings → {.5, .6}, Alignment → Center
], SpanFromLeft
},
{
  Grid[{
    {
      Grid[{
        {Item[Style["modes to excite", 12], Alignment → Center], SpanFromLeft},
        {
          Grid[{
            {Style["m", Italic, 12],
              TogglerBar[Dynamic[m0, {m0 = #} &], Range[5]]
            },
            {Style["n", Italic, 12],
              TogglerBar[Dynamic[n0, {n0 = #} &], Range[5]]
            }
          ], Spacings → {.3, .2}, Alignment → Left
        }
      ], Spacings → {.5, .6}, Alignment → Center
    }
  ], Spacings → {.3, .6}, Alignment → Center,
  Frame → True, FrameStyle → Directive[Thickness[.001], Gray]
}

```

```

]
}
,
{
  Grid[{
    {
      Grid[{
        {
          Text@"contour lines",
          Manipulator[
            Dynamic[contoursLines, {contoursLines = #} &], {1, 16, 1}, ImageSize → Small,
            ContinuousAction → True], Dynamic[padIt2[contoursLines, 2]], ""
        }
      ], Spacings → {.3, .1}, Alignment → Left
    ]
  ], Spacings → {.5, .6}, Alignment → Center, Frame → False], SpanFromLeft
}

}, Alignment → Center, Spacings → {0.5, .4},
Frame → True, FrameStyle -> Directive[Thickness[.001], Gray]
],

{{color, 1}, None},
{{tension, 0.1}, None},
{{ρ0, 1}, None},
{{opacity, .8}, None},
{{yMax, 1.6}, None},
{{t0, 0}, None},
{{a0, 100}, None},
{{b0, 100}, None},
{{m0, {1}}, None},
{{n0, {1}}, None},
{{meshLines, 10}, None},
{{plotType, "3D"}, None},
{{contoursLines, 10}, None},

SynchronousUpdating → False,
Alignment → Center,
ImageMargins → 2, (*important*)
FrameMargins → 1,
SynchronousInitialization → True,
ContinuousAction → False,
Alignment -> Center,
Paneled → True,
Frame → False,
AutorunSequencing → Automatic,

ControlPlacement → Left,
Initialization =>
{

```

```

integerStrictPositive = (IntegerQ[#] && # > 0 &);
integerPositive = (IntegerQ[#] && # ≥ 0 &);
numericStrictPositive = (Element[#, Reals] && # > 0 &);
numericPositive = (Element[#, Reals] && # ≥ 0 &);
numericStrictNegative = (Element[#, Reals] && # < 0 &);
numericNegative = (Element[#, Reals] && # ≤ 0 &);
bool = (Element[#, Booleans] &);
numeric = (Element[#, Reals] &);
integer = (Element[#, Integers] &);

(*-----*)
(* helper function for formatting *)
(*-----*)
padIt1[v_?numeric, f_List] := AccountingForm[Chop[v], f,
  NumberSigns → {"-", "+"}, NumberPadding → {"0", "0"}, SignPadding → True];
(*-----*)
(* helper function for formatting *)
(*-----*)
padIt2[v_?numeric, f_List] := AccountingForm[Chop[v], f,
  NumberSigns → {"", ""}, NumberPadding → {"0", "0"}, SignPadding → True];
padIt2[v_?numeric, f_Integer] := AccountingForm[Chop[v], f,
  NumberSigns → {"", ""}, NumberPadding → {"0", "0"}, SignPadding → True];
(*-----*)
w[x_, y_, a_, b_, mm_, nn_, c_, t_, t0_] := Module[{m, n, f},
  Sum[Sum[
    If[MemberQ[mm, m] && MemberQ[nn, n],
      f = N@freq[c, a, b, m, n];
      Cos[ $\frac{m \pi x}{a/2}$ ] Cos[ $\frac{n \pi y}{a/2}$ ] If[t0 == 0, 1, (Cos[f t] + Sin[f t])], 0],
    {m, 1, 5}],
    {n, 1, 5}]
];
(*-----*)
freq[c_, a_, b_, m_, n_] := Pi c  $\sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2}$ ;
(*-----*)
getW[c_, a_, b_] := Module[{m, n, g, wmn},
  g = Table[0, {6}, {6}];
  wmn = Table[padIt2[N@freq[c, a, b, m, n] / (2 * Pi), {6, 2}], {m, 1, 5}, {n, 1, 5}];
  g[[1, All]] = {"", 1, 2, 3, 4, 5};
  g[[All, 1]] = {"", 1, 2, 3, 4, 5};
  g[[2 ;;, 2 ;;]] = wmn;
  g[[1, 1]] = Style["n\\m", Italic];
  Grid[g, Frame → All,
    FrameStyle → Directive[Thickness[.001], Gray], Spacings → {.8, .8}]
];
}

```

]

Out[]=

$$\frac{\partial^2 u(x,y,t)}{\partial x^2} + \frac{\partial^2 u(x,y,t)}{\partial y^2} = \frac{1}{c^2} \frac{\partial^2 u(x,y,t)}{\partial t^2}$$
$$\lambda = (c \pi) \sqrt{\frac{m^2}{a^2} + \frac{n^2}{b^2}} \text{ (hz)}$$

T

00.1 N/mm

ρ

0.1 kg/mm²

a

0010 mm

b

0010 mm

modes to excite

m

1

2

3

4

5

n

1

2

3

4

5

contour lines

10

