Multivariable Calculus Computer Algebra Project 2014

Assignment

Be creative. If you use inspiration beyond these templates, give credit. Use the above templates to do the following:

1) (3 points) A parametric surface of your choice.
2) (3 points) A vector field of your choice.
3) (4 points) An arbitrary object or combination of your choice.

Submit your notebook after removing all the graphics in the above menu Cell -> Delete All Output.

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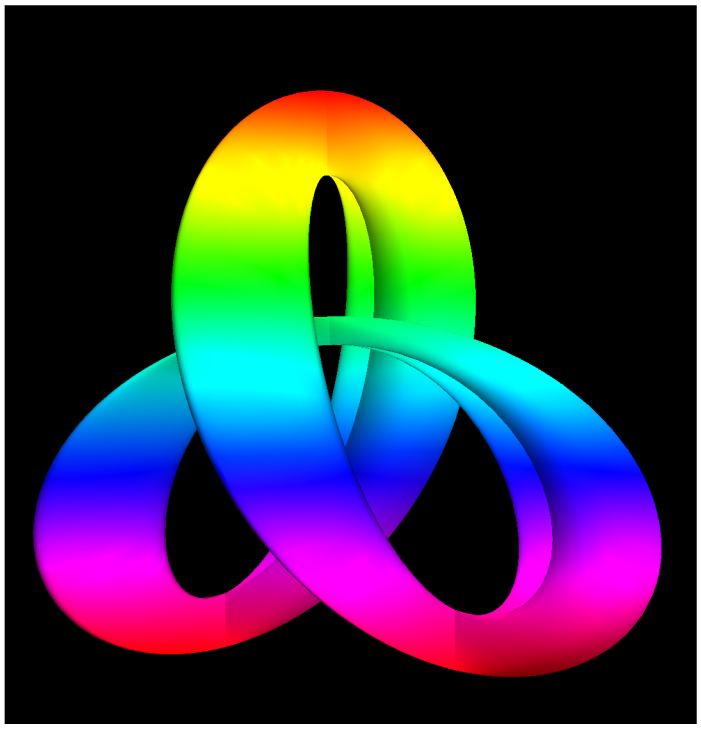
Alex Andonian

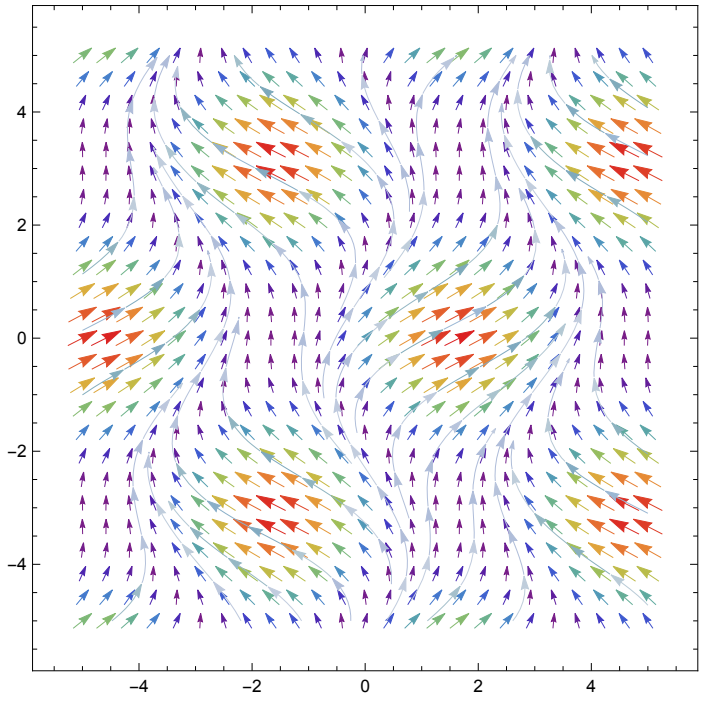
1. Parametric Surface:

```
ParametricPlot3D[{2 Sin[2 u] / (2 + Cos[2 v]), 2 Sin[u] + 2 Sin[2 u] / (2 + Cos[v + 2 Pi / 3]),
   (Cos[u] - 2 Cos[2 u]) * (2 + Cos[v]) * (2 + Cos[v + 2 Pi / 2]) / 3},
 {u, 0, 2 Pi}, {v, 0, Pi}, Mesh → None, ColorFunction → Hue,
 Background → Black, Axes -> False, Boxed → False, PlotPoints → 100,
 ViewPoint → {-2.245, 2.5, 0.1}, ViewVertical → {0.03, 0.001, -1.04}]
```



2. Vector Field:

```
VectorPlot[{Sin[x] + Cos[y], (Sin[y] + Cos[x]) / Sqrt[(Sin[y] + Cos[x])]^2},
 {x, -5, 5}, {y, -5, 5}, VectorPoints -> Fine, VectorColorFunction → "Rainbow",
 StreamPoints → 25, StreamColorFunction -> "Aquamarine"]
```



3. Violin

```
Body1 = ParametricPlot3D[{{-3.25 Cos[t] Sin[p], -3.2 Sin[t] Sin[p], (1 / 8) Cos[p]},
    {5 + 2.9 Cos[t] Sin[p], 2.8 Sin[t] Sin[p], (1 / 8) Cos[p]}}, {t, -1.92, 1.92},
   {p, Pi / 2, Pi}, Mesh → None, PlotStyle → Directive[{Texture[
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]}]];
Body2 = ParametricPlot3D[{{-3.25 Cos[t] Sin[p], -3.2 Sin[t] Sin[p], 1 + (1 / 8) Cos[p]},
    {5 + 2.9 Cos[t] Sin[p], 2.8 Sin[t] Sin[p], 1 + (1 / 8) Cos[p]}}, {t, -1.92, 1.92},
   {p, 0, Pi / 2}, Mesh → None, PlotStyle → Directive[{Texture[
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]}]];
Scroll = ParametricPlot3D[{{14.95 + (-E^t Sin[-8 t]) / 26, (5 (1.5) u / Sqrt[t]) / 26,
     1.505 + ((E^t Cos[-8 t]) / 26)}, {14.95 + (-Abs[u] E^(t) Sin[-8 t]) / 26,
     (((1.5) 5 (u) / Sqrt[t])) / 26, 1.505 + ((Abs[u] E^(t) Cos[-8 t]) / 26)}},
   {t, .5, 2.9}, {u, -1, 1}, PlotPoints -> {40, 15}, Mesh → False,
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    PlotStyle → Directive[{Texture[ ]}]];

Strings = ParametricPlot3D[
    {{{.25, 0.27, 1.25} + {((2) - .25) t, (0.42 - 0.27) t, (1.65 - 1.25) t}},
     {{.25, 0.09, 1.25} + {((2) - .25) t, ((0.14) - 0.09) t, (1.65 - 1.25) t}},
     {{.25, -0.09, 1.25} + {((2) - .25) t, ((-0.14) - (-0.09)) t, (1.65 - 1.25) t}},
     {{2, -0.42, 1.65} +
       {(((13.75 + 14.65) / 2) - 2) t, (-0.225 - (-0.42)) t, (1.375 - 1.65) t}},
     {{.25, -0.27, 1.25} + {((2) - .25) t, (-0.42 - (-0.27)) t, (1.65 - 1.25) t}},
     {{2, 0.42, 1.65} + {(((13.75 + 14.65) / 2) - 2) t, (0.225 - 0.42) t, (1.375 - 1.65) t}},
     {{2, 0.14, 1.65} +
       {(((13.75 + 14.65) / 2) - 2) t, ((0.075) - 0.14) t, (1.375 - 1.65) t}},
     {{2, -0.14, 1.65} + {(((13.75 + 14.65) / 2) - 2) t,
        ((-0.075) - (-0.14)) t, (1.375 - 1.65) t}}}, {t, 0, 1},
    PlotStyle → {{Gray, Thin}, {Gray, Thin}, {Gray, Thin}, {Gray, Thin},
      {Gray, Thin}, {Gray, Thin}, {Gray, Thin}, {Gray, Thin}}];
PegBox = Show[ContourPlot3D[{y == .375, y == -.375}, {x, 13.75, 14.65}, {y, -1, 1}, {z,

      1.1, 1.375}, Mesh → False, ContourStyle → Directive[{Texture[ ]}]],

    ContourPlot3D[z == 1.1, {x, 13.75, 14.65}, {y, -.375, .375}, {z, 1, 2},

     Mesh → False, ContourStyle → Directive[{Texture[ ]}]]];

Shoulders = ParametricPlot3D[{{-3.25 Cos[t], -3.2 Sin[t], z},
     {5 + 2.9 Cos[t], 2.8 Sin[t], z}}, {t, -1.92, 1.92},
    {z, 0, 1}, Mesh → False, BoundaryStyle → Directive[Black, Thick],

    PlotStyle → Directive[{Texture[ ]}]];

RWaist = ParametricPlot3D[{2.6 + 1.5 Cos[t], -2.9 + Sin[t], z}, {t, .25, Pi + .135},

    {z, 0, 1}, Mesh → False, PlotStyle → Directive[{Texture[ ]}],

    BoundaryStyle → Directive[Black, Thick]];

LWaist = ParametricPlot3D[{2.6 - 1.5 Cos[t], 2.9 - Sin[t], z}, {t, -0.135, Pi - .25},

    {z, 0, 1}, Mesh → False, PlotStyle → Directive[{Texture[ ]}],

    BoundaryStyle → Directive[Black, Thick]];

Waist = Show[LWaist, RWaist, PlotRange → Automatic];
FingerB = ParametricPlot3D[{x + 23, 1 / 24 x * Cos[t], 1.25 + 1 / 96 x * Sin[t]},
    {t, 0, 2 Pi}, {x, -20, -8.35}, MeshStyle → Opacity[0.1],
    PlotStyle → Directive[RGBColor[0.125, 0.125, 0.125]]];
ChinRest = ParametricPlot3D[{Cos[t] Sin[p] - 2, 1.5 Sin[t] Sin[p] + .65,
     1.25 + 1 / 4 Cos[p]}, {t, 0, 2 Pi}, {p, 0, Pi}, Mesh → False,
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    PlotStyle → Directive[RGBColor[0.125, 0.125, 0.125]]];
TailPiece = ParametricPlot3D[{x - 12, 1 / 24 x * Cos[t], 1.25 + 1 / 96 x * Sin[t]},
    {t, 0, 2 Pi}, {x, 10, 12.5}, Mesh → False,
    PlotStyle → Directive[RGBColor[0.125, 0.125, 0.125]]];
Bridge = ContourPlot3D[x == 2, {x, 0, 4}, {y, -.7, .7}, {z, 1, 1.65},
 Mesh -> None, ContourStyle -> Directive[{Texture[ ]}]];
v17 = ContourPlot3D[z == 0.99, {x, -1, 4.05336}, {y, -3, 0}, {z, 0, 2},
    RegionFunction → Function[{x, y, z}, 1 < (x - 2.6) ^ 2 / (1.5) ^ 2 + (y + 2.9) ^ 2], Mesh →
     None, ContourStyle → Directive[{Texture[ ]}], BoundaryStyle → None];
v18 = ContourPlot3D[z == 0.99, {x, -1, 4.05336}, {y, 0, 3}, {z, 0, 2}, RegionFunction →
     Function[{x, y, z}, 1 < (x - 2.6) ^ 2 / (1.5) ^ 2 + (y - 2.9) ^ 2], Mesh → None,
    ContourStyle → Directive[{Texture[ ]}], BoundaryStyle → None];
v19 = ContourPlot3D[{z == 0.99, z == .01}, {x, 4.05336, 5.25},
    {y, -2.652596, 2.652596}, {z, 0, 2}, Mesh → None,
    ContourStyle → Directive[{Texture[ ]}], BoundaryStyle → None];
v20 = ContourPlot3D[z == .01, {x, -1, 4.05336}, {y, -3, 0}, {z, 0, 2}, RegionFunction →
     Function[{x, y, z}, 1 < (x - 2.6) ^ 2 / (1.5) ^ 2 + (y + 2.9) ^ 2], Mesh → None,
    ContourStyle → Directive[{Texture[ ]}], BoundaryStyle → None];
v21 = ContourPlot3D[z == .01, {x, -1, 4.05336}, {y, 0, 3}, {z, 0, 2}, RegionFunction →
     Function[{x, y, z}, 1 < (x - 2.6) ^ 2 / (1.5) ^ 2 + (y - 2.9) ^ 2], Mesh → None,
    ContourStyle → Directive[{Texture[ ]}], BoundaryStyle → None];
Pegs1 = ParametricPlot3D[{{(13.75 + 1 / 10 Cos[t] Sin[t]), (1 + 2 / 10 Sin[t] Sin[p]),
      ((1.1 + 1.375) / 2 + 3 / 12 Cos[p])}, {(14.25 + 1 / 10 Cos[t] Sin[t]),
      (1 + 2 / 10 Sin[t] Sin[p]), ((1.1 + 1.375) / 2 + 3 / 12 Cos[p])},
     {(14 + 1 / 10 Cos[t] Sin[t]), (-1 + 2 / 10 Sin[t] Sin[p]),
      ((1.1 + 1.375) / 2 + 3 / 12 Cos[p])}, {(14.5 + 1 / 10 Cos[t] Sin[t]),
      (-1 + 2 / 10 Sin[t] Sin[p]), ((1.1 + 1.375) / 2 + 3 / 12 Cos[p])}}, {t, 0, 2 Pi},
    {p, 0, Pi}, Mesh → False, PlotStyle → Directive[{Texture[ ]}],
    BoundaryStyle → None];
Pegs2 = Graphics3D[{{Black, Cylinder[{{13.75, 0, ((1.1 + 1.375) / 2)},
        {13.75, 0.825, ((1.1 + 1.375) / 2)}}, 0.075]}, {Black, Cylinder[
       {{14.25, 0, ((1.1 + 1.375) / 2)}, {14.25, 0.825, ((1.1 + 1.375) / 2)}}, 0.075]},
     {Black, Cylinder[{{14, 0, ((1.1 + 1.375) / 2)}, {14, -0.825, ((1.1 + 1.375) / 2)}},
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      0.075]}, {Black, Cylinder[
      {{14.5, 0, ((1.1 + 1.375) / 2)}, {14.5, -0.825, ((1.1 + 1.375) / 2)}}, 0.075]}}];
Pegs = Show[Pegs1, Pegs2];

LeftFHole = ContourPlot3D[z == 1.01, {x, 1, 3.5}, {y, 1, 2}, {z, 0, 2}, Mesh → False,
   ContourStyle → Directive[{Texture[ ]}], BoundaryStyle → None];

RightFHole = ContourPlot3D[z == 1.01, {x, 1, 3.5}, {y, -2, -1}, {z, 0, 2}, Mesh → False,
   ContourStyle → Directive[{Texture[ ]}], BoundaryStyle → None];

FineTuner = Graphics3D[{Gray, Cylinder[{{.3, -0.3, 1.35}, {.3, -0.3, 1.4}}, 0.15]}];


Bow[Pos_] :=
 Graphics3D[{{RGBColor[0.125, 0.125, 0.125],
    Cuboid[{2.4, Pos, 1.65}, {2.6, Pos + 1, 2.1}]}, {RGBColor[0.6, 0.21, 0.09],
    Cylinder[{{2.5, Pos - (1 / 2), 2.1}, {2.5, Pos + 20.75, 2.1}}, 0.1]},
   {RGBColor[0.6, 0.21, 0.09], Hexahedron[{{2.4, Pos + 20, 1.65}, {2.6, Pos + 20, 1.65},
      {2.6, Pos + 21, 1.65}, {2.4, Pos + 21, 1.65}, {2.4, Pos + 20, 2.1},
      {2.6, Pos + 20, 2.1}, {2.6, Pos + 20.75, 2.1}, {2.4, Pos + 20.75, 2.1}}]},
   {ContourPlot3D[z == 1.65, {x, 2.4, 2.6}, {y, Pos + 1, Pos + 21}, {z, 1, 2},
      Mesh → False, ContourStyle → Directive[RGBColor[0.94, 0.93, 0.79]]][[1]]}}]


ViolinBow[BowPos_] :=
 Show[Body1, Body2, Scroll, Strings, Shoulders, PegBox, Waist, FingerB, ChinRest,
  TailPiece, Bridge, v17, v18, v19, v20, v21, Pegs, RightFHole, LeftFHole, FineTuner,
  Bow[-BowPos], PlotRange -> All, Boxed -> False, Axes -> False, ImageSize -> Full]
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BowPos ∈ [0,20] with BowPos[0]→Frog and BowPos[20]→Tip.

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ViolinBow[10]
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(*Frames=
 Flatten[{{Table[ViolinBow[a],{a,20}]},{Reverse[Table[ViolinBow[a],{a,20}]]}}];
Export["Violin.Mov",Frames]*)
```