Parametric equations for a surface in 3-space have the form

$$x = f(u, v) \qquad y = g(u, v) \qquad z = h(u, v).$$

There are two aspects to getting comfortable with parametric equations for surfaces:

1. Given the parametrization, understanding the surface.
2. Given the surface, being able to figure out the parametrization.

That is,

1. Given the parametric equations, what is the relationship between x, y, and z?
2. Given the relationship between x, y, and z, what is the parametrization?

Recall:

$$\cosh(x) = \frac{e^x + e^{-x}}{2}$$

Note: cosh(x) is always positive

$$\sinh(x) = \frac{e^x - e^{-x}}{2}$$

Note: sinh(x) may be negative

In Class Work

(a) Express the given surface using relationship(s) between x, y, and z.
(b) Sketch traces & identify the surface without using Maple or the book.
(c) Plot on Maple to check. Compare how Maple plots the parametric equations with how the surface looks using implicitplot3d.

1. $$x = u \qquad y = 3u^2 + 2v^2 \qquad z = v.$$

2. $$x = v\sinh(u) \qquad y = 4v^2 \qquad z = v\cosh(u).$$

Maple Example:

- `[2*cos(u)*sin(v), 2*sin(u)*sin(v), 6*cos(v)];`
  right click on blue result
  `plots-plot builder - 3D parametric plot`
- `(x/2)^2+(y/2)^2+(z/6)^2=1;`
  right click on blue result
  `plots-3D implicit plot - x,y,z`

Recall:

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- When we have $y = f(x)$, we parametrize that by $x = t, y = f(t)$.