Vector Calculus (1B)

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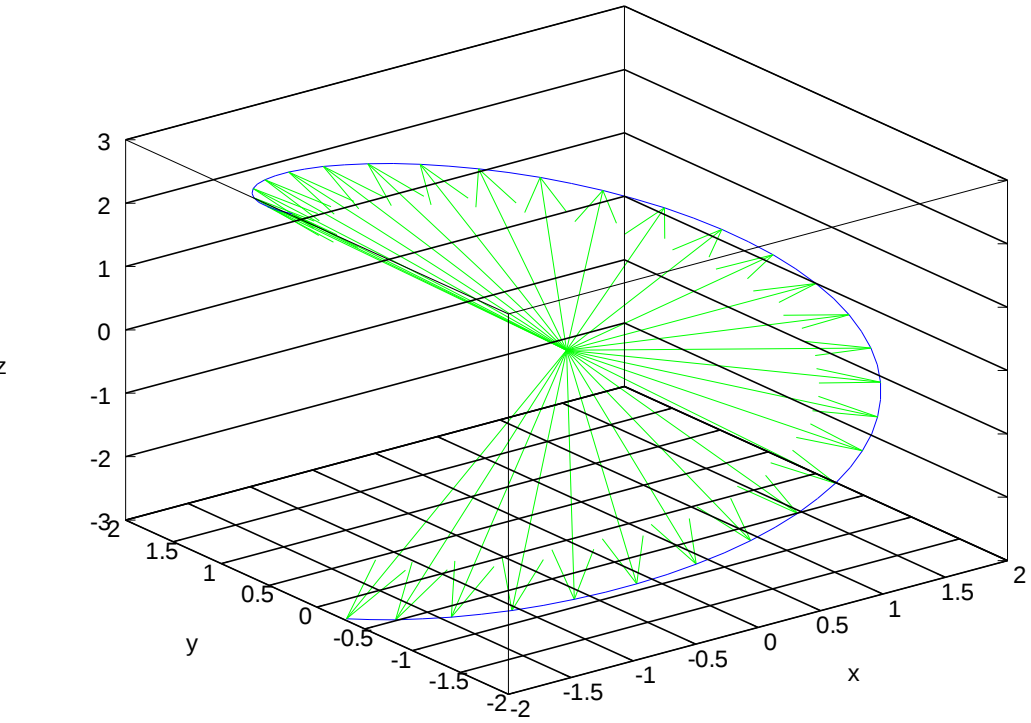
Plotting a Circular Helix

$$\boldsymbol{r}(t) = 2\cos t\,\boldsymbol{i} + 2\sin t\,\boldsymbol{j} + t\,\boldsymbol{k}$$

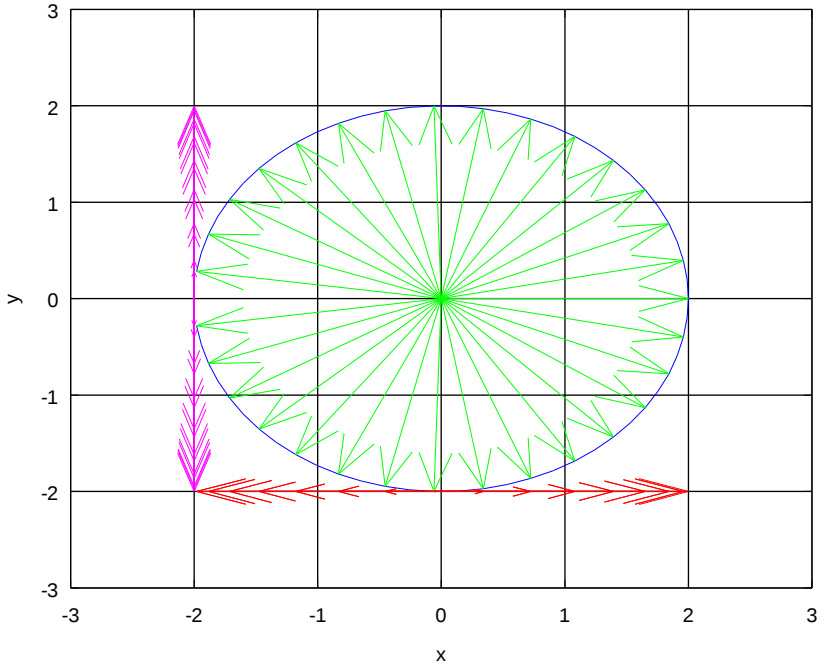


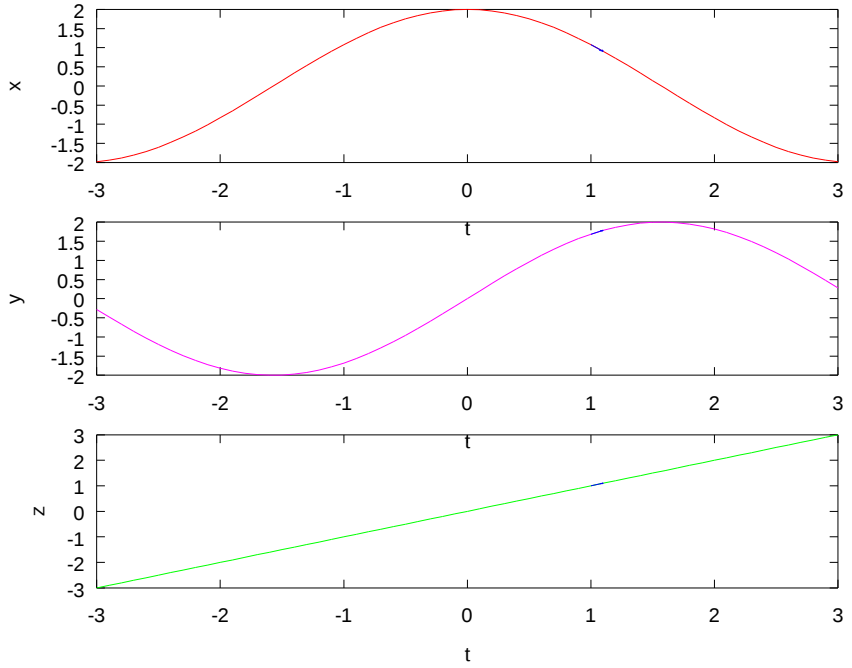

```
%-------------------------------------------------------------------------
% 3-d Helix Drawing
% Licensing: This code is distributed under the GNU LGPL license.
% Modified: 2012.09.10
% Author: Young W. Lim
%-------------------------------------------------------------------------

clf ;
t = -3 : 0.1 : +3;
x = 2 * cos(t);
y = 2 * sin(t);
z = t ;

plot3(x, y, z);

grid on
xlabel("x");
ylabel("y");
zlabel("z");

hold on;
for i = -3: 0.2 : +3;
  h=quiver3(0, 0, 0, 2*cos(i), 2*sin(i), i);
  set(h, "color", "green");
endfor
```

Plane Plotting of a Circular Helix (1)

$$\boldsymbol{r}(t) = 2\cos t\,\boldsymbol{i} + 2\sin t\,\boldsymbol{j} + t\,\boldsymbol{k}$$

$$x = 2\sin t$$
$$y = 2\cos t$$
$$y = t$$





Plotting a Circular Helix (2)

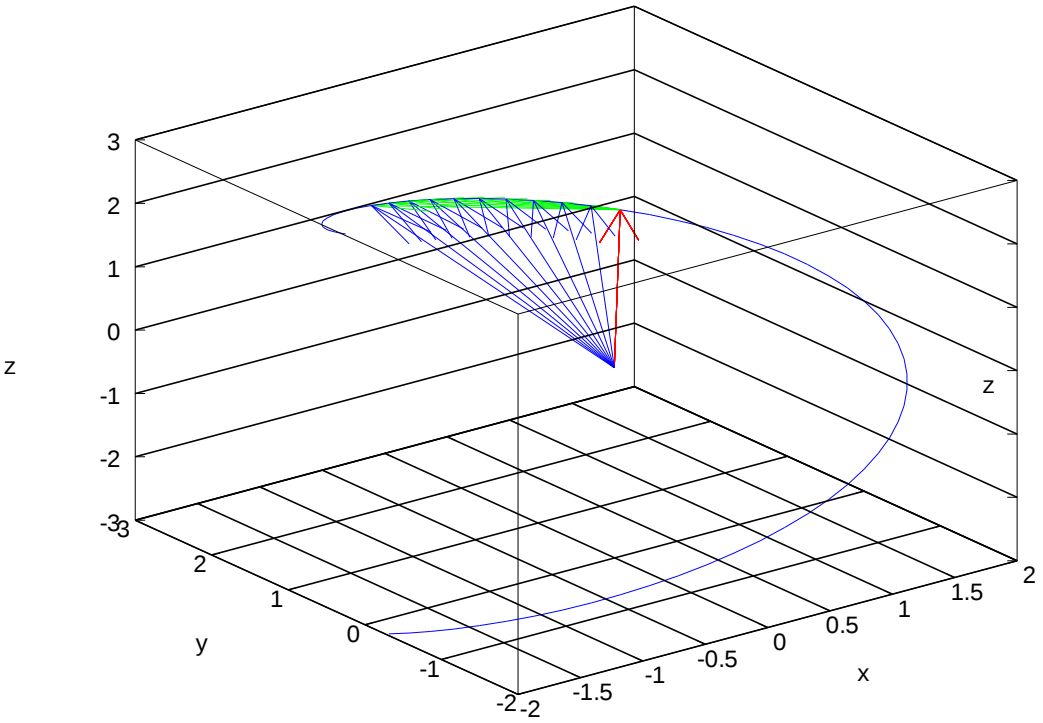
```
%-------------------------------------------------------------------------
% 3-d Line
% Licensing: This code is distributed under the GNU LGPL license.
% Modified: 2012.09.10
% Author: Young W. Lim
%-------------------------------------------------------------------------

clf ;
t = -3 : 0.1 : +3;
x = 2 * cos(t);
y = 2 * sin(t);
z = t ;

plot(x, y);

grid on
xlabel("x");
ylabel("y");
zlabel("z");

axis([-3 +3 -3 +3]);

hold on;
for i = -3: 0.2 : +3;
  h1=quiver(0, 0, 2*cos(i), 2*sin(i));
  h2=quiver(0, -2, 2*cos(i), 0);
  h3=quiver(-2, 0, 0, 2*sin(i));
  set(h1, "color", "green");
  set(h2, "color", "red");
  set(h3, "color", "magenta");
  pause(0.5);
endfor
```

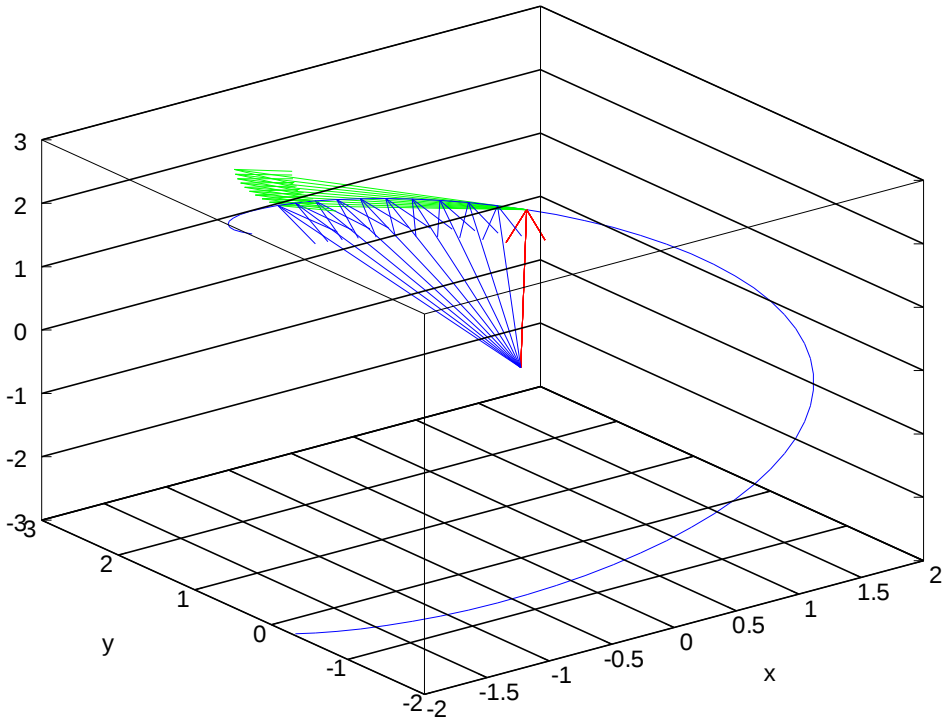
```
%-------------------------------------------------------------------------
% X-Y-Z Drawing of a Circular Helix
% Licensing: This code is distributed under the GNU LGPL license.
% Modified: 2012.09.10
% Author: Young W. Lim
%-------------------------------------------------------------------------

clf;

subplot(3, 1, 1);
plot(t, x, "color", "red");
hold on;
h=quiver(1, 2*cos(1), 0.1, 2*(cos(1.1)-cos(1)));
set(h, "color", "blue");
xlabel("t");
ylabel("x");

subplot(3, 1, 2);
plot(t, y, "color", "magenta");
hold on;
h=quiver(1, 2*sin(1), 0.1, 2*(sin(1.1)-sin(1)));
set(h, "color", "blue");
xlabel("t");
ylabel("y");

subplot(3, 1, 3);
plot(t, z, "color", "green");
hold on;
h=quiver(1, 1, 0.1, 0.1);
set(h, "color", "blue");
xlabel("t");
ylabel("z");
```

Plotting a Tangent Vector (1)

$$\Delta \boldsymbol{r} = \boldsymbol{r}(t + \Delta t) - \boldsymbol{r}(t)$$

$$\frac{\Delta \boldsymbol{r}}{\Delta t} = \frac{\boldsymbol{r}(t + \Delta t) - \boldsymbol{r}(t)}{\Delta t}$$





Plotting a Tangent Vector (2)

```
%-------------------------------------------------------------------------
% Secant Vectors of a Circular Helix
% Licensing: This code is distributed under the GNU LGPL license.
% Modified: 2012.09.10
% Author: Young W. Lim
%-------------------------------------------------------------------------

clf ;
t = -3 : 0.1 : +3;
x = 2 * cos(t);
y = 2 * sin(t);
z = t ;

plot3(x, y, z);

grid on
xlabel("x");
ylabel("y");
zlabel("z");


hold on;
for i = 1: -0.1 : 0.1;
  h1=quiver3(0, 0, 0, 2*cos(1), 2*sin(1), 1);
  h2=quiver3(0, 0, 0, 2*cos(1+i), 2*sin(1+i), 1+i);
  h3=quiver3(2*cos(1), 2*sin(1), 1, 2*cos(1+i)-2*cos(1),
                  2*sin(1+i)-2*sin(1), i);

  set(h1, "color", "red");
  set(h2, "color", "blue");
  set(h3, "color", "green");
  pause(0.2);
endfor
```

```
%-------------------------------------------------------------------------
% Tangent Vector of a Circular Helix
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% Modified: 2012.09.10
% Author: Young W. Lim
%-------------------------------------------------------------------------

clf ;
t = -3 : 0.1 : +3;
x = 2 * cos(t);
y = 2 * sin(t);
z = t ;

plot3(x, y, z);

grid on
xlabel("x");
ylabel("y");
zlabel("z");


hold on;
for i = 1: -0.1 : 0.1;
  h1 = quiver3(0, 0, 0, 2*cos(1), 2*sin(1), 1);
  h2 = quiver3(0, 0, 0, 2*cos(1+i), 2*sin(1+i), 1+i);
  h3 = quiver3(2*cos(1), 2*sin(1), 1, (2*cos(1+i)-2*cos(1))/i,
                  (2*sin(1+i)-2*sin(1))/i, 1);

  set(h1, "color", "red");
  set(h2, "color", "blue");
  set(h3, "color", "green");
  pause(0.2);
endfor
```

Right Hand Rule

References

[1] http://en.wikipedia.org/
[2] http://planetmath.org/
[3] M.L. Boas, “Mathematical Methods in the Physical Sciences”
[4] D.G. Zill, “Advanced Engineering Mathematics”