Solving the Frenet System,
for prescribed curvature and torsion functions
Math 4530 Spring 02

```
> restart:
> with(DEtools):with(plots):
     #need DEtools to solve differential equations
Warning, the name changecoords has been redefined
```

Here's a pretty self-explanatory procedure which solves the Frenet system, taken more or less from the text.

```
> recreate3dview:=proc(kap,ta,a,b,c,d,e,f,g,h)
     #kap=curvature,ta=torsion
     #arclength parameter from a to b
     #c..d, e..f, g..h are x-y-z ranges for plot
  local
     sys,   #the Frenet system
     p ,    #dummy for ODE solution to Frenet system
     ics,   #initial conditions
     p1;    #name for ODEplot of p
  sys:=
     diff(alph1(s),s)=T1(s),
     diff(alph2(s),s)=T2(s),
     diff(alph3(s),s)=T3(s),
     diff(T1(s),s)=kap(s)*N1(s),
     diff(T2(s),s)=kap(s)*N2(s),
     diff(T3(s),s)=kap(s)*N3(s),
     diff(N1(s),s)=-kap(s)*T1(s)+ta(s)*B1(s),
     diff(N2(s),s)=-kap(s)*T2(s)+ta(s)*B2(s),
     diff(N3(s),s)=-kap(s)*T3(s)+ta(s)*B3(s),
     diff(B1(s),s)=-ta(s)*N1(s),
     diff(B2(s),s)=-ta(s)*N2(s),
     diff(B3(s),s)=-ta(s)*N3(s);
  ics:=
     alph1(0)=0,alph2(0)=0,alph3(0)=0,
     T1(0)=1,T2(0)=0,T3(0)=0,
     N1(0)=0,N2(0)=1,N3(0)=0,
     B1(0)=0,B2(0)=0,B3(0)=1;
  p:=dsolve({sys,ics},{alph1(s),alph2(s),alph3(s),
     T1(s),T2(s),T3(s),N1(s),N2(s),N3(s),
     B1(s),B2(s),B3(s)},type=numeric);
  p1:=odeplot(p,[alph1(s),alph2(s),alph3(s)],a..b,
     numpoints=200,thickness=1,axes=boxed,color=black):
  display(p1,scaling=constrained,view=[c..d,e..f,g..h]);
  end:
```

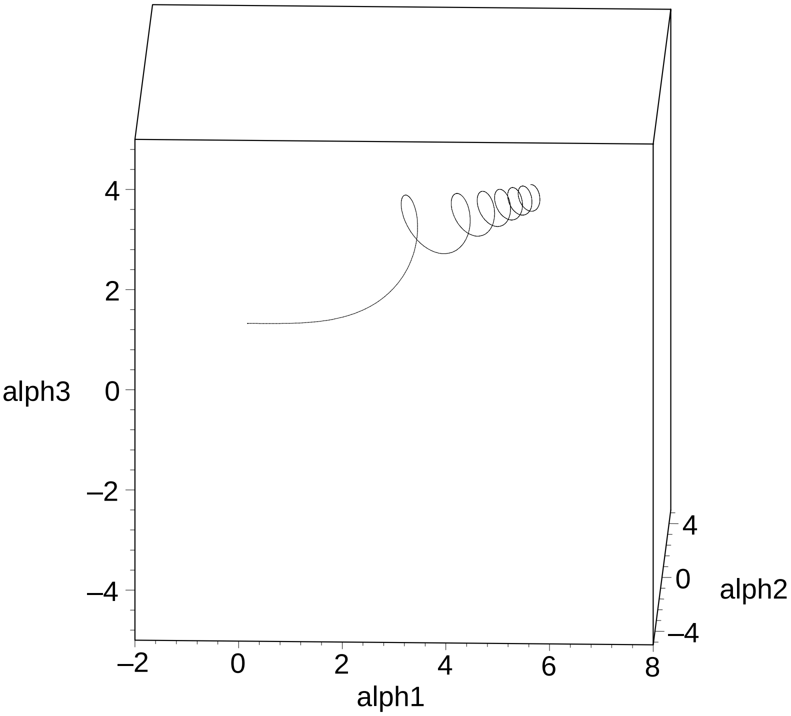
Here are some examples:
Example 1: A helix, with constant curvature and torsion

```
> kap1:=s->.2*s;
  tor1:=s->.5;
```

$$kap1 := s \rightarrow .2\ s$$

$$tor1 := .5$$

```
> recreate3dview(kap1,tor1,0,20,-2,8,-5,5,-5,5);
```



```
>
```