Introduction to Flight Simulation (Exercise List 12)

Due: ± 20 feb 2011

1. There is a nice web site,

   `http://www.arndt-bruenner.de/mathe/scripts/kubspline.htm,`

   that contains a tool that can compute splines. 'Berechnen' means 'Calculate' and you should set 'Koeffizienten' to '12 Dezimalstellen'.

   You may use it to implement functions that computes C_L, C_D, and CP from a given angle of attack α, using the tables in the text `forces.pdf`.

   Since α is going to be computed from an arc tangent, it is probably a good idea to base the spline polynomials on $\tan(\alpha)$, rather than on α itself.

2. You can cut each wing of the B737-300 into four fragments. Guess for each of the fragments (for example by looking at pictures of a flying B737) the dihedral angle and the fixed angle of attack. Note that both the dihedral angle and the fixed angle of attack may be different for the different fragments.

   Using your results of List 9, you can now compute a quaternion for each of the wing fragments which represents its rotation relative to the airplane.

3. Use the result of the previous task, and the following struct

```
struct force_torque
{
   linalg::vector force;
   linalg::vector torque;

   force_torque( )
      : force( linalg::vector::vector( 0.0, 0.0, 0.0 )),
        torque( linalg::vector::vector( 0.0, 0.0, 0.0 ))
   { }
```

```
    force_torque( const linalg::vector& force,
                  const linalg::vector& position )
       : force( force ),
         torque( linalg::crossproduct( position, force ))
    { }
};
```

to write a function

```
force_torque wing( quaternion orientation, vector speed,
                   vector angular_speed )
```

that computes the force and torque on the main wings of the B737 from its orientation, speed and angular speed. (All in external coordinates.)

If you can do this task, then this means that understand how flight simulation works. The other aerodynamic surfaces are similar.