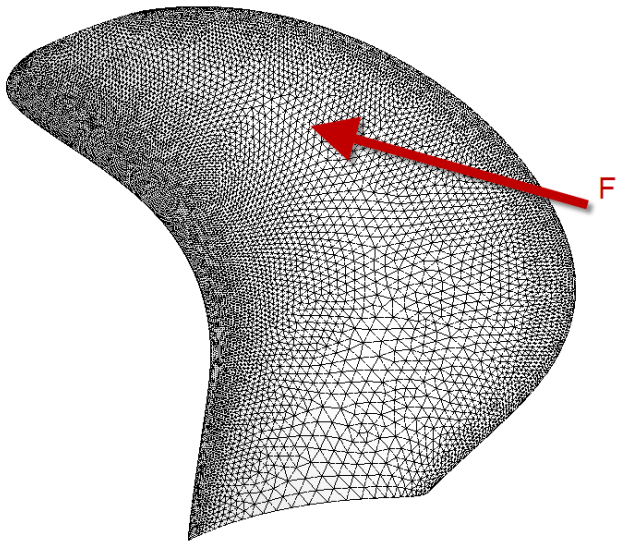
Rolls-Royce Problem

For some propeller blades, a strength analysis that simulates blade failure is required. The blade is fixed at the bottom and a force is applied at a given position and with a given direction and magnitude.



In the FEM model the force vector F cannot be applied in one point but must be replaced by a force distribution over the nodes in a given area. The force vector on each node has the same direction as F but the magnitudes must be set so the resulting force and torque is the same as F gives. In order to avoid large deformations, the force magnitudes should be kept within limits.
A base line force magnitude distribution is the one that gives a uniform pressure. It is estimated as

$$F_i^m = w\frac{1}{n}F^m$$

where m denotes magnitude, n is the total number of nodes and w is a weight factor calculated as one over the area of the triangles attached to node i (scaled so the sum of all weights is one). With the weight factor, the magnitudes will be smaller in areas with more node per area unit.

It is desirable that the resulting force magnitude is as close to the base line distribution as possible. How can this best be achieved?