

Q1.  $F_{wind} \propto Area * dot(wind, normal) * normal$

Q2. Study the roots  $(r_1, r_2)$  of the associated characteristic equation

$$x^2 - (2 - h^2 K/m)x + 1 = 0$$

Solutions as  $p^n = A r_1^n + B r_2^n$

Set  $y = h^2 K/m$

$$\Rightarrow x^2 + (y - 2)x + 1 = 0$$

$$\Delta = (y - 2)^2 - 4 = y(y - 4), \text{ with roots } r = ((2 - y) \pm \sqrt{y(y - 4)})/2$$

Sign of delta:

1st case:  $\Delta > 0 \Rightarrow y < 0$  or  $y > 4$ .

Note:  $h^2 K/m > 4 \Rightarrow h > 2/\sqrt{K/m}$

Plot  $r$  for  $y < 0$  and  $y > 4$ , and see that  $|r| > 1 \Rightarrow$  unstable

2nd case:  $\Delta < 0 \Rightarrow h < 2/\sqrt{K/m}$

$$\Rightarrow r = 0.5(2 - y \pm i\sqrt{y(4 - y)})$$

$$\Rightarrow |r| = 0.5\sqrt{(2 - y)^2 + y(4 - y)}$$

$$= 0.5\sqrt{4 - 4y + y^2 + 4y - y^2}$$

$$= 0.5\sqrt{4}$$

$$= 1$$

$\Rightarrow$  Permanent oscillation solution