Cup Anemometer Overspeeding

Statistical considerations are applied to a general equation of motion for cup anemometers in a turbulent wind. It is shown that the relative overspeeding $\Delta S/S$ can be expressed as $\Delta S/S = I_h z^2 \cdot J_s(l_0/\Lambda_s) + c I_w z^2$, where $I_s$ and $I_w$ are the horizontal and the vertical turbulence intensifies, respectively. The function $J_s$ depends on the shape of the spectrum of horizontal turbulent energy, $l_0$ is the distance constant for the anemometer, and $\Lambda_s$ is a characteristic length scale of the horizontal turbulence. The constant $c$ is of order unity.

If $\Lambda_s$ is suitably chosen as the scale of the energy-containing eddies, then $J_s$ is satisfactorily approximated by $J_s = (1 + \Lambda_s/l_0)^{-1}$ in most atmospheric applications.