From Olsen, Blum, & Rigaut (2003, AJ, 126, 452), the following expression relates the surface brightness of the environment, the distance modulus, the photometric error, and the stellar magnitude for a general luminosity function $\Phi(M)$, under the assumption that all of the photometric error is due to crowding:

$$\Sigma_m > 2M - 2.5\log\left[\frac{4}{\pi}\left(\frac{\sigma_m}{1.086a_{\rm res}}\right)^2 \times \frac{\int_{M_{\rm lo}}^{M_{\rm hi}} 10^{-0.4M'}\Phi(M')dM'}{\int_{M_{\rm lo}}^{M} 10^{-0.8M'}\Phi(M')dM'}\right] + (m-M)_0$$

(1)

If we adopt a luminosity function $\phi(L)\propto L^{\alpha}$ (such that $\log_{10}\Phi(M)=-0.4(\alpha+1)M$ + const.), then we get a clean analytical expression for the crowding-induced photometric error σ_m:

$$\sigma_m = 10^{-0.2(\Sigma_m-(m-M)_0-2M+M_{\rm lo})}\left(\frac{1.086a_{\rm res}}{2}\sqrt{\pi\frac{(2+\alpha)(10^{-0.4(3+\alpha)(M-M_{\rm lo})}-1)}{(3+\alpha)(10^{-0.4(2+\alpha)(M_{\rm hi}-M_{\rm lo})}-1)}}\right)$$

(2)

For stellar populations with ages >~3 Gyr in the near-infrared, α=-1.84 is a good approximation to a luminosity function drawn from a Salpeter IMF. In the plots below, I show the power-law luminosity function $\phi(L)\propto L^{-1.85}$ (black line) compared to luminosity functions with ages 1 Gyr (blue line), 5 Gyr (green line), and 10 Gyr (red line) and solar metallicity, as calculated from Padova isochrones. In the plot on the right I show the corresponding crowding-induced photometric errors vs. K magnitude, assuming Σ_K=18 mags arcsec^{-2}, $(m\text{-}M)_0$=24.45, and a diffraction-limited 10-m telescope. For the discrete ages, the calculation was done numerically using equation (1), while for the power-law LF I used the purely analytical equation (2).