Comparison 2D Jet Derivations

1.

$$u(x,y) = \left(\frac{J^2}{C^2\rho^2\nu x}\right)^{1/3} \operatorname{sech}^2\left(\frac{y}{\sqrt{6}}\left[\frac{J}{C\rho\nu^2x^2}\right]^{1/3}\right)$$

$$C = \frac{4\sqrt{6}}{3} \quad \frac{y}{\sqrt{6}}\left[\frac{J}{C\rho\nu^2x^2}\right]^{1/3} = y\left(\frac{J}{48\nu^2\rho}\right)^{1/3} x^{-2/3}$$

$$u_0(x) = \left[\frac{J^2}{C^2\rho^2\nu x}\right]^{1/3} = \left[\frac{3J^2}{32\rho^2\nu x}\right]^{1/3} \propto x^{-1/3}$$

$$\delta(x) = \left[\frac{C\rho\nu^2x^2}{J}\right]^{1/3} = \left[\frac{4\sqrt{6}J\rho\nu^2x}{3J}\right]^{1/3} \propto x^{2/3}$$

$$\dot{m} = (36J\,\rho^2\nu x)^{1/3} \propto x^{1/3}$$

$$h_{99} = 5.6152\left[\frac{C\rho\nu^2x^2}{J}\right]^{1/3} = 5.6152\left[\frac{4\sqrt{6}}{3}\frac{\rho\nu^2x^2}{J}\right]^{1/3}$$

2.

$$u = \left(\frac{3}{32}\frac{M^2}{\nu\rho^2}\right)^{1/3} x^{-1/3} f'(\eta) = u_{max}\operatorname{sech}^2\eta$$

$$\eta = \frac{y}{b(x)} = y\left(\frac{M}{48\nu^2\rho}\right)^{1/3} x^{-2/3}$$

$$h(x) = \mathrm{C}\left(\frac{48\nu^2\rho}{M}\right)^{1/3} x^{2/3}$$

$$Q = \left(\frac{36M\nu}{\rho}\right)^{1/3} x^{1/3}$$

3.

$$u = u_{max}\,\mathrm{sech}^2(\alpha\eta) = u_{max}\,\mathrm{sech}^2\left[\underbrace{0.2752\left(\frac{\rho J}{\mu^2 x^2}\right)^{1/3} y}_{\alpha\eta}\right]$$

$$u_{max} = \frac{2}{3}\left(\frac{9}{16}\right)^{2/3}\frac{J^{2/3}}{(\rho\mu x)^{1/3}} = \left(\frac{3}{32}\right)^{1/3}\frac{J^{2/3}}{(\rho\mu x)^{1/3}} \approx 0.4544\left(\frac{J^2}{\rho\mu x}\right)^{1/3}$$

$$\propto x^{-1/3}$$

$$b(x) = 3\nu^{1/2}x^{2/3}$$

$$2y|_{1\%} \approx 21.8\left(\frac{\mu^2}{\rho J}\right)^{1/3} x^{2/3}$$

$$\dot{m} = (36\mu\rho J x)^{1/3} \approx 3.302\,(\mu\rho J x)^{1/3}$$