$$V_p = \sqrt{2}\left[\frac{-\mu}{r_1+r_2} + \frac{\mu}{r_1}\right]^{1/2} = \left(\frac{\mu}{r_1}\right)^{1/2}\left[2 - \frac{2}{1+r_2/r_1}\right]^{1/2} = V_{c1}\left[2 - \frac{2}{1+r_2/r_1}\right]^{1/2}$$

$$\Delta V_1 = V_p - V_{c1} = V_{c1}\left\{\left[2 - \frac{2}{1+r_2/r_1}\right]^{1/2} - 1\right\}$$

$$V_a = \sqrt{2}\left[\frac{\mu}{r_2} - \frac{\mu}{r_1+r_2}\right]^{1/2} = \left(\frac{\mu}{r_2}\right)^{1/2}\left[2 - \frac{2}{1+r_1/r_2}\right]^{1/2} = V_{c2}\left[2 - \frac{2}{1+r_1/r_2}\right]^{1/2}$$

$$\Delta V_2 = V_{c2} - V_a = V_{c2}\left\{1 - \left[2 - \frac{2}{1+r_1/r_2}\right]^{1/2}\right\}$$

$$\Delta V = \Delta V_1 + \Delta V_2$$

$$= V_{c1}\left\{\left[2 - \frac{2}{1+r_2/r_1}\right]^{1/2} - 1\right\} + V_{c2}\left\{1 - \left[2 - \frac{2}{1+r_1/r_2}\right]^{1/2}\right\}$$

$$= V_{c1}\left\{\left[2 - \frac{2}{1+r_2/r_1}\right]^{1/2} - 1 + \frac{V_{c2}}{V_{c1}} - \frac{V_{c2}}{V_{c1}}\left[2 - \frac{2}{1+r_1/r_2}\right]^{1/2}\right\}$$

$$= V_{c1}\left\{\left(2 - \frac{2}{1+r_2/r_1}\right)^{1/2} + \sqrt{\frac{r_1}{r_2}}\left[1 - \left(2 - \frac{2}{1+r_1/r_2}\right)^{1/2}\right] - 1\right\}$$