$$V_{ADIBLC} = \frac{(V_{gsteff} + 2v_t)}{\theta_{rout} t(1 + P_{DIBLCB} V_{bseff})}\left(1 - \frac{A_{bulk} V_{dsat}}{A_{bulk} V_{dsat} + V_{gsteff} + 2v_t}\right) \tag{3.5.5}$$

$$\theta_{rout} = P_{DIBLC1}\left[\exp(-D_{ROUT}\frac{L_{eff}}{2l_{t0}}) + 2\exp(-D_{ROUT}\frac{L_{eff}}{l_{t0}})\right] + P_{DIBLC2} \tag{3.5.6}$$

$$\frac{1}{V_{ASCBE}} = \frac{P_{scbe2}}{L_{eff}}\exp\left(\frac{-P_{scbe1}\, litl}{V_{ds} - V_{dsat}}\right) \tag{3.5.7}$$

3.6 Single Current Expression for All Operating Regimes of V_{gs} and V_{ds}

The V_{gsteff} function introduced in Chapter 2 gave a unified expression for the linear drain current from subthreshold to strong inversion as well as for the saturation drain current from subthreshold to strong inversion, *separately.* In order to link the continuous linear current with that of the continuous saturation current, a smooth function for V_{ds} is introduced. In the past, several smoothing functions have been proposed for MOSFET modeling [22-24]. The smoothing function used in BSIM3 is similar to that proposed in [24]. The final current equation for both linear and saturation current now becomes

$$I_{ds} = \frac{I_{dso(Vdseff)}}{1 + \frac{R_{ds} I_{dso(Vdseff)}}{V_{dseff}}}\left(1 + \frac{V_{ds} - V_{dseff}}{V_A}\right)\left(1 + \frac{V_{ds} - V_{dseff}}{V_{ASCBE}}\right) \tag{3.6.1}$$

Most of the previous equations which contain V_{ds} and V_{dsat} dependencies are now substituted with the V_{dseff} function. For example, Eq. (3.5.4) now becomes