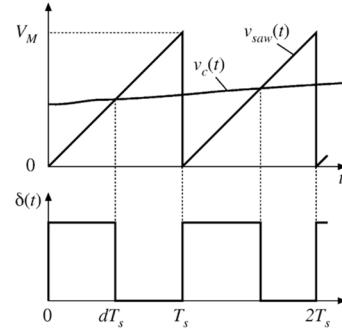
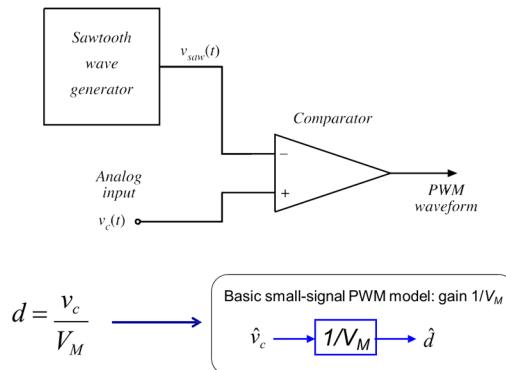


Changing Duty Cycle



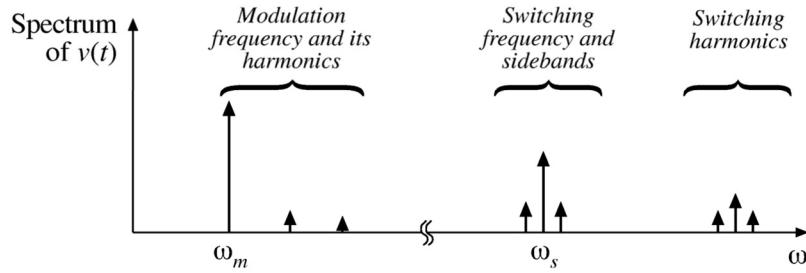
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Another View: PWM Modulator



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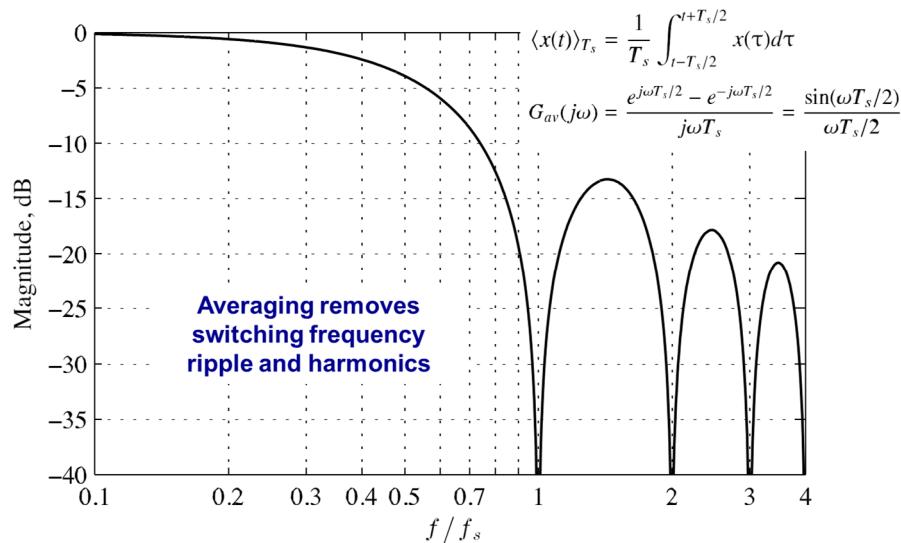
Average Modeling



$$\langle x(t) \rangle_{T_s} = \frac{1}{T_s} \int_{t-T_s/2}^{t+T_s/2} x(\tau) d\tau$$

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Averaging: Frequency Domain View



State Space Solution

A. R. Brown and R. D. Middlebrook, "Sampled-Data Modeling of Switching Regulators", 1981



The Matrix Exponential

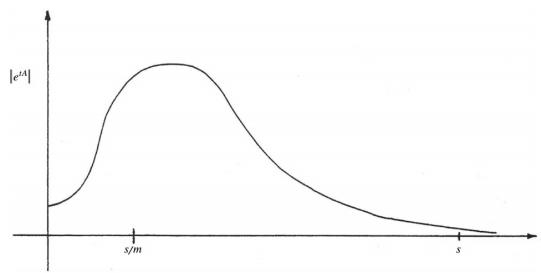
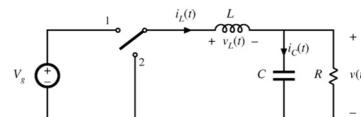


Fig. 1 The "hump".

C. Moler and C. V. Loan, "Nineteen Dubious Ways to Compute the Exponential of a Matrix, Twenty-Five Years Later"



Application to Switching Systems



Discrete Time Model

