Presentation on SVC Modelling

Sub Title:- Modeling for Stability Studies

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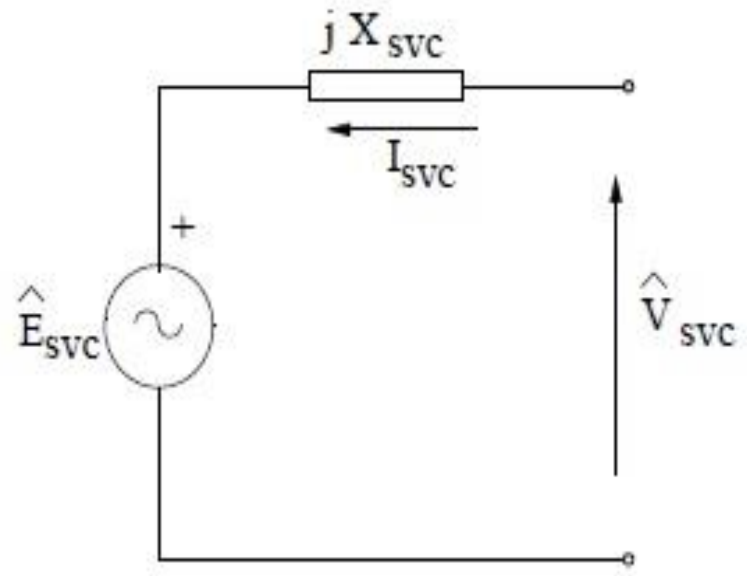
Steady State Model of SVC

The steady state control characteristics are modelled by an equivalent circuit shown in Figure.This shows a complex voltage source E_{SVC} in series with a reactance X_{SVC}.The losses in the SVC are neglected. The values of E_{SVC} and X_{SVC} are given below for the SVC operating in (i) the control range,

(ii) capacitive limit and

(iii) inductive limit

Equivalent circuit of SVC



SVC operating in the control range

$$\hat{E}_{SVC} = V_{ref}\angle\phi_{SVC}$$
$$X_{SVC} = X_s$$

where φSVC is the angle of the SVC bus voltage. The control range applies when the SVC bus voltage lies in the range.

$$\frac{V_{ref}}{1 + X_s B_{max}} < V_{SVC} < \frac{V_{ref}}{1 + X_s B_{min}}$$

where B_{min} and B_{max} are the limits of B_{SVC}. Note that B_{min} is, in general, negative (corresponding to the inductive limit) and B_{max} = BC, where B_C is the total capacitive susceptance. (neglecting the transformer leakage reactance)

At Capacitive Limit :

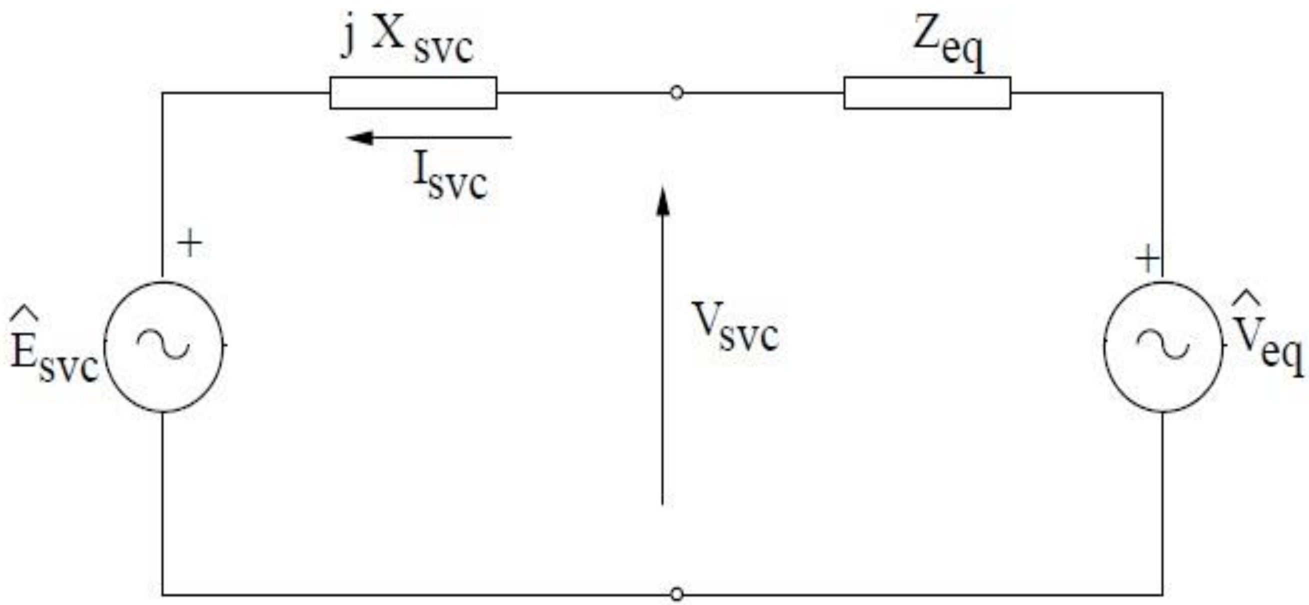
$$\hat{E}_{SVC} = 0.0 + j0.0 \qquad X_{SVC} = -\frac{1}{B_{max}}$$

At inductive Limit :

$$\hat{E}_{SVC} = 0.0 + j0.0 \qquad X_{SVC} = -\frac{1}{B_{min}}$$

The equivalent circuit of SVC for the control range is nonlinear (since the angle of E_{SVC} depends on the bus voltage) and is time varying when the limits are considered. Thus, in general, the inclusion of SVC model in transient stability simulation, involves iterative network solution. However, with nonlinear voltage dependant static load models in the system, the handling of SVC is no more complicated than the handling of nonlinear loads.

SVC connected to Thevenin equivalent



From Figure, the SVC current can be computed as

$$\hat{I}_{SVC} = \frac{\hat{V}_{eq} - \hat{E}_{SVC}}{Z_{eq} + jX_{SVC}}$$

If $\hat{E}_{SVC}$ = 0.0+j0.0, the solution is straight forward. However, in the control range, the angle φ_{SVC} needs to be known to apply Eq

It can be shown that tan$_\phi$SVC is obtained as the solution of aquadratic equation given by

$$a \tan^2 \phi_{SVC} + b \tan \phi_{SVC} + c = 0$$

where

$$\begin{aligned}
a &= x^2 - z^2 \sin^2 \alpha, \\
b &= -2xy, \\
c &= y^2 - z^2 \sin^2 \alpha \\
x &= Re[(1 - \hat{A})\hat{V}_{eq}], \quad y = Im[(1 - \hat{A})\hat{V}_{eq}] \\
z &= |\hat{A}|V_{ref} \\
\hat{A} &= A\angle\alpha = \frac{Z_{eq}}{Z_{eq} + jX_{SVC}}
\end{aligned}$$

Thank You