UNIT IV

STABILITY ANALYSIS

Transient Stability Analysis

- For transient stability analysis we need to consider three systems

1. Prefault - before the fault occurs the system is assumed to be at an equilibrium point
2. Faulted - the fault changes the system equations, moving the system away from its equilibrium point
3. Postfault - after fault is cleared the system hopefully returns to a new operating point

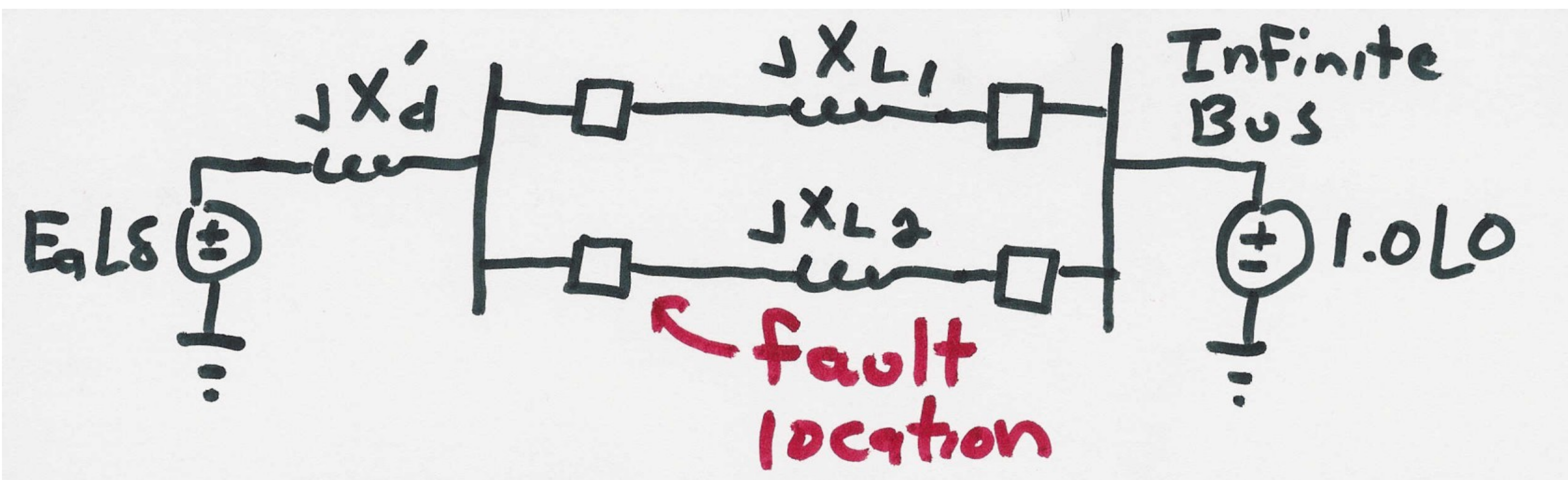
Transient Stability Solution Methods

- There are two methods for solving the transient stability problem

1. Numerical integration
   - this is by far the most common technique, particularly for large systems; during the fault and after the fault the power system differential equations are solved using numerical methods
2. Direct or energy methods; for a two bus system this method is known as the equal area criteria
   - mostly used to provide an intuitive insight into the transient stability problem

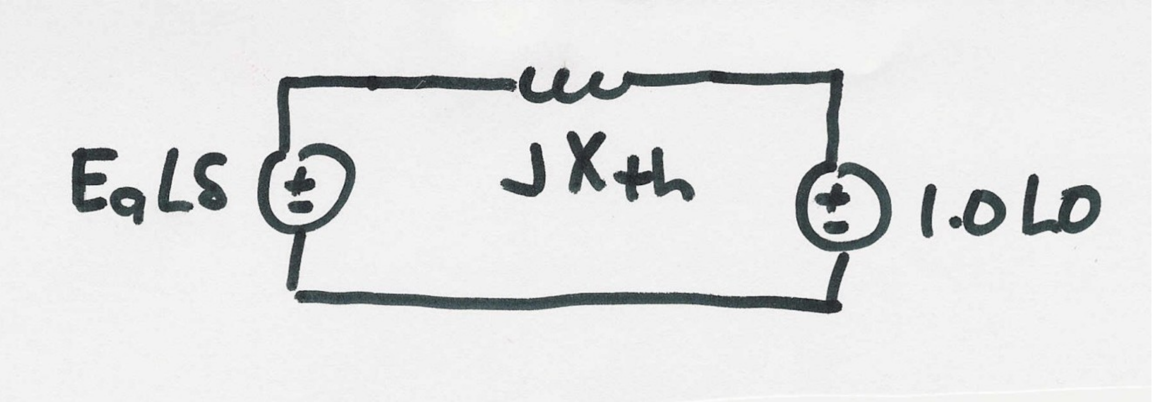
SMIB Example

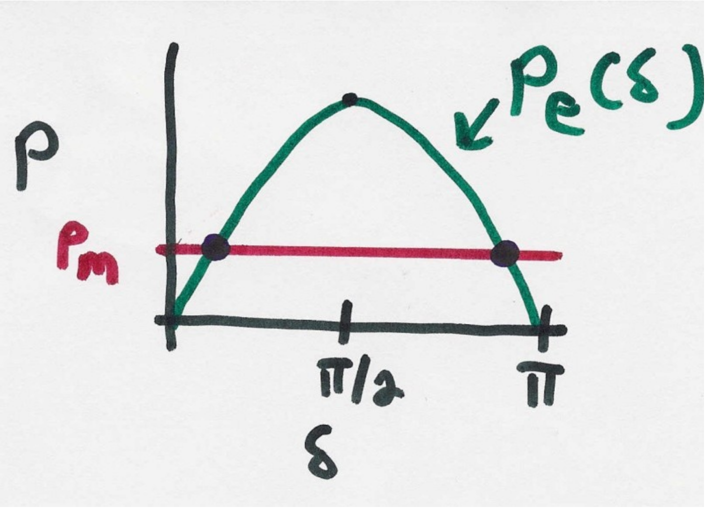
- Assume a generator is supplying power to an infinite bus through two parallel transmission lines. Then a balanced three phase fault occurs at the terminal of one of the lines. The fault is cleared by the opening of this line's circuit breakers.



SMIB Example, cont'd

Simplified prefault system



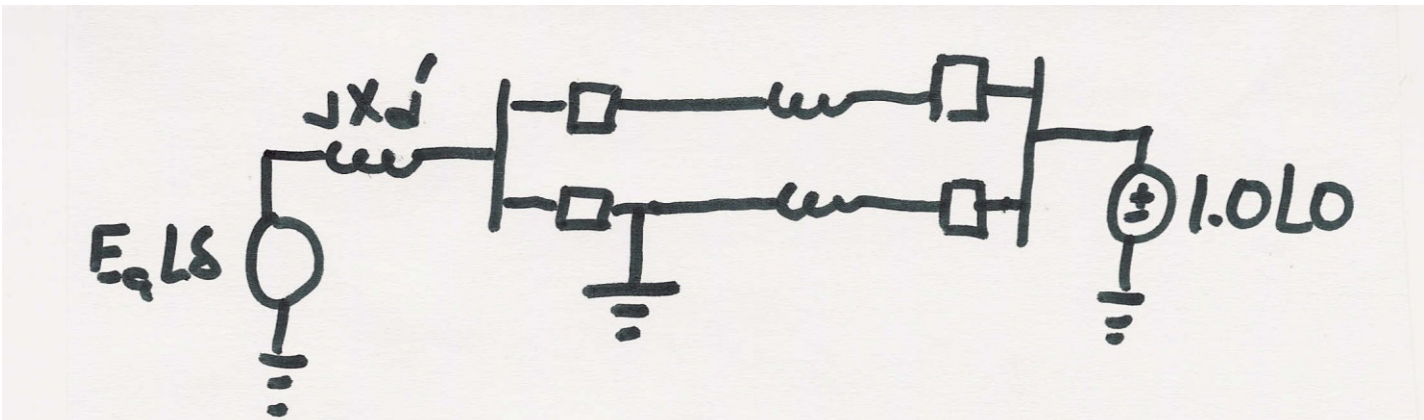


The prefault system has two equilibrium points; the left one is stable, the right one unstable

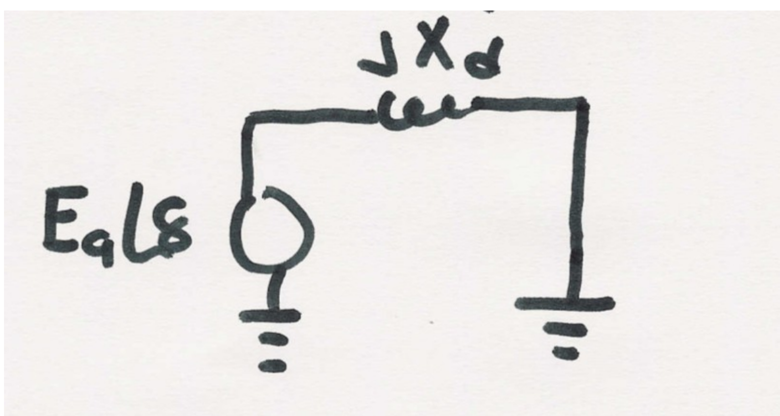
$$\delta = \sin^{-1}\left(\frac{P_M X_{th}}{E_a}\right)$$

SMIB Example, Faulted System

During the fault the system changes



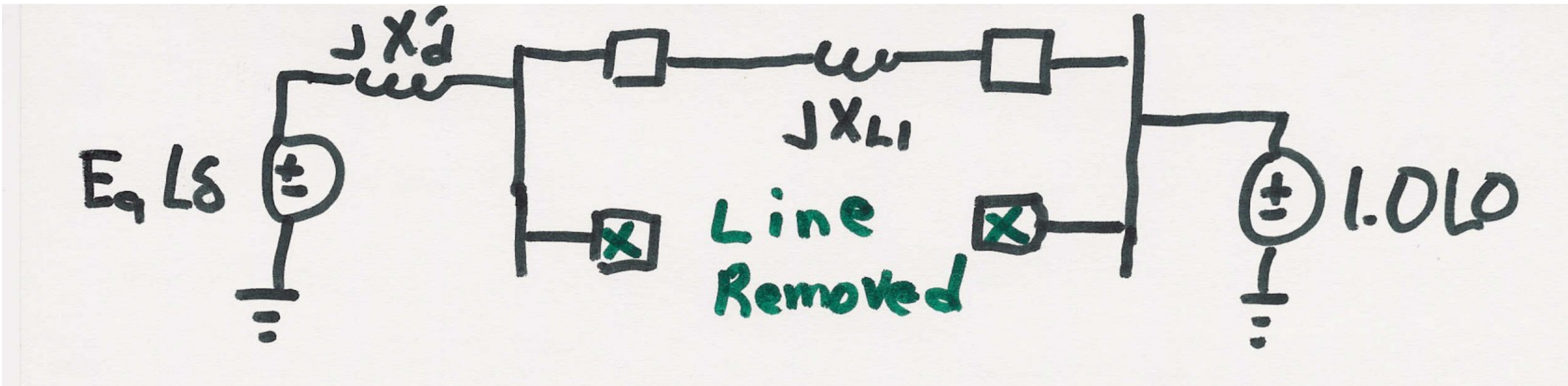
The equivalent system during the fault is then



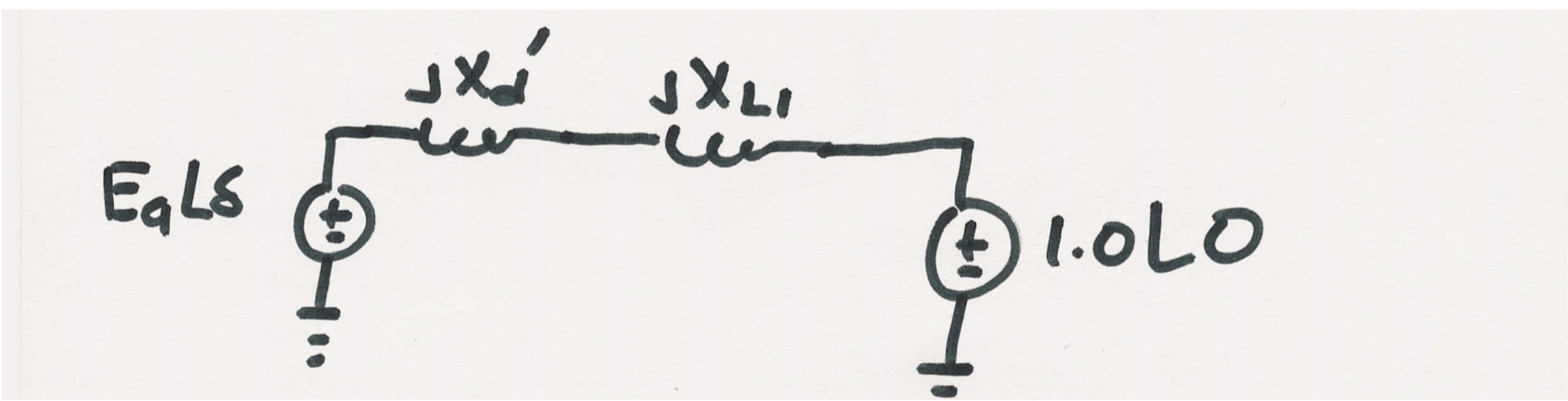
During this fault no power can be transferred from the generator to the system

SMIB Example, Post Fault System

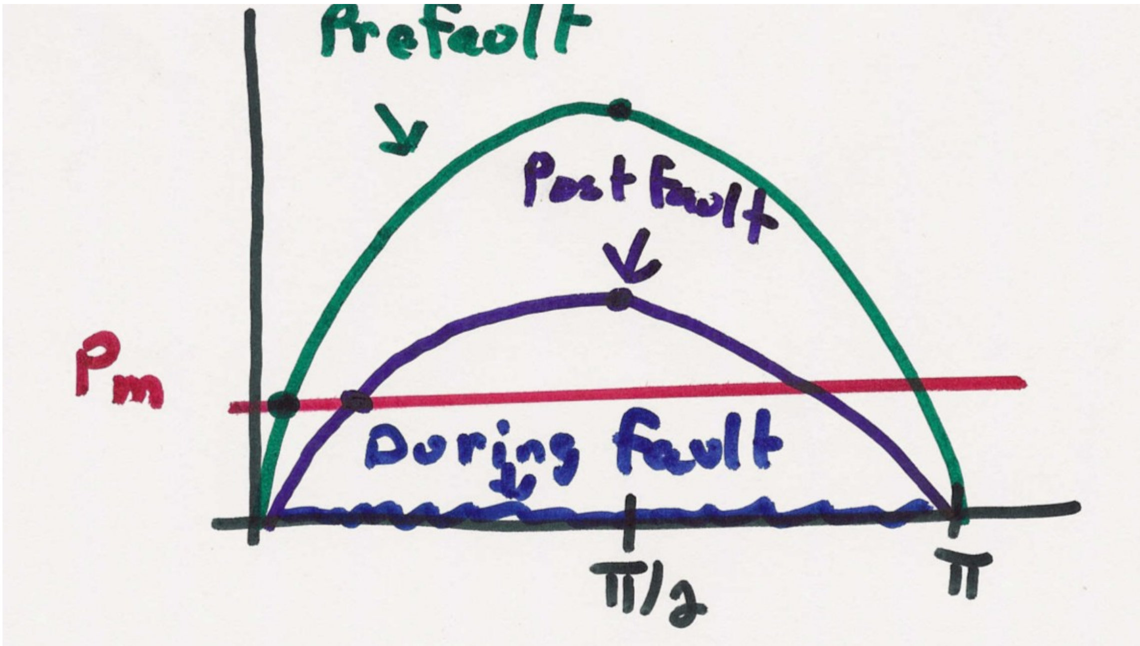
After the fault the system again changes



The equivalent system after the fault is then



SMIB Example, Dynamics



During the disturbance the form of $P_e(\delta)$ changes, altering the power system dynamics:

$$\ddot{\delta} = \frac{1}{M}\left[P_M - \frac{E_a V_{th}}{X_{th}} \sin\delta\right]$$

Thank you