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# Optimal design and application of fuzzy logic equipped control in STATCOM to abate SSR oscillations

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**Summary**

The phenomenon of subsynchronous resonance (SSR) is important to understand the operation and stability of the power system. The system becomes vulnerable to SSR oscillations due to series compensation that is unavoidable as it enhances transmission capability. So different alleviation measure is necessary, and this paper presents a novel control with the implementation of fuzzy logic control (FLC) and active disturbance rejection control (ADRC) for the abatement of SSR using a static synchronous compensator (STATCOM). This control can compensate for reactive power as well as alleviate SSR oscillations. Both the proposed controllers have the inherent capability to overcome the limitation of proportional and integral (PI) in a non-linear framework. In the proposed control, the use of a phase-locked loop is eliminated, thus providing a faster response. Thus, the proposed algorithm highly enhances the capability of STATCOM in controlling the level of series compensation, which results in a substantial reduction of the SSR oscillations. To validate the effectiveness of the proposed algorithm, an IEEE second benchmark model is simulated. Furthermore, the dynamics of SSR are put forth through various analyses, such as, eigenvalue analysis, frequency scan, fast Fourier analysis, and time-domain analysis, which helps to better understand the problem of SSR.

**KEYWORDS**

ADRC, FACTS, frequency scan, fuzzy logic control, STATCOM, subsynchronous resonance, torsional oscillations

## 1 | INTRODUCTION

Working towards enhancing the stability and transmission capability of the system, series compensation plays an indispensable role.[1] However, it is the main cause of subsynchronous resonance (SSR) oscillations in power system. Providing reliable and qualitative electric power to the customers is the primary goal of all the electrical utilities.[2,3] SSR not only diminishes the quality of electric power but also damages the electric power system components and generating units. Since replacing the existing series compensated transmission lines with new ones is difficult and cost ineffective, other measures are necessary to mitigate SSR oscillations.[4] Trend to utilize the wind energy is on the rise and series compensation thus seem to be unavoidable.[5–7]

According to the definition given by IEEE,[8] "SSR is an electrical power system condition where the electrical network exchanges energy with a turbine generator at one or more of the natural frequencies of the combined system below the synchronous frequency of the system." Drastic nature of SSR can be seen right from its first recorded incident

  