

 <a href="http://d2.cigre.org">http://d2.cigre.org</a> /	CONSEIL INTERNATIONAL DES GRANDS RESEAUX ELECTRIQUES INTERNATIONAL COUNCIL ON LARGE ELECTRIC SYSTEMS
	<b>STUDY COMMITTEE D2</b> INFORMATION SYSTEMS AND TELECOMMUNICATION

**2017 Colloquium**  
**September 20 to 22, 2017**  
**Moscow – RUSSIA**

## PS2

### **Improving accuracy of power system state estimation under cyber-attacks using median filtering**

**A.L. KULIKOV, I.A. LUKICHEVA**  
**NNSTU n.a. R.E. Alexeev, Skoltech**  
**Russia**

Under transition to Smart Grids, threats of cyber-attacks are becoming increasingly relevant. The most assailable points are communicational channels of monitoring and automatic control systems. Data communication of currents, voltages and other parameters with gross errors or zero values can distort results of power system state estimation and ultimately cause incorrect actions of the control system.

The authors propose the usage of median filtering in order to increase accuracy of power system state estimation (SE) under cyber-attacks.

Median filtering (MF) is a nonlinear signal processing technique useful for noise suppression, which found wide application in digital image processing. It is performed by letting a window move over the points of a sequence and replacing the value at the window center with the median of the original values within window. The advantage of the proposed method is that MF enables us to discard the values with low accuracy, thus avoiding the impact of the bad data on SE. It should be mentioned that the method is easy to implement.

MF advantage foundation was performed by modeling of an electrical grid section in software package PSCAD. Data used in state estimator was taken from the model. In the model, values were measured by phasor measurement units. SE was performed on the basis of the obtained measurements by Least Square Method (LSM) with additional one-dimensional and two-dimensional MF. Results of SE showed that under cyber-attacks on communication channels LSM is not sufficiently effective in terms of measurement accuracy improvement, since one large error in a measurement array "spoils" the overall estimated power system state and the rest values of regime parameters. Whereas MF provided high accuracy.

Thus, MF is considered to be a promising tool for SE tasks solving, using of which will lead to higher reliability of electrical grids in case of cyber-attacks.