could be estimated through physical modeling or through the assessment of historical PQ data. In Chapter **??**, using a real power quality dataset, we have shown how accurately an $f(d)$ could be estimated.

2. *All potential malfunction devices need to be on a monitored segment.* A potential malfunction device could effectively be detected when the device itself or any of its child device is monitored in real time using a PQ meter. This assumption is realistic in the sense that if the underline link is not monitored, we cannot get the real-time status of PQ values and would not be able to detect if a device is not behaving normally. The idea is to detect if a device is significantly deviating form its normal behavior.

3. *The power grid network is a tree-structured network where the electric current flows from root node to the child nodes.*

4. *The probability mass function $\big(pmf\,(d_0)\big)$ of power quality values at the input link to the root node is known*

   - If no smart meter installed on that device, need to estimate from neighboring links
   - The metered link detects deviation and estimate the deviations of all devices between itself and parent metered link

1.3   Our Prediction Algorithm

1.4   Evaluations

Assume that one or more smart meters have continuously measured poor power quality. The power quality is indicated by some specific power quality index, for instance the System Average RMS Variation Frequency (SARFI) index . Based on the measured and estimated PQ values, we would like to know which device is most likely to be malfunctioning. Here, we assume that we know the transform function of each device if the device is working properly. We call these transfer functions the regular transform functions of the devices. Now, a malfunctioning device is the one whose estimated transform function deviates significantly from its regular transform function.

CHAPTER 1. A PREDICTION MODEL 3

We plan to first give a comprehensive mathematical model of the problem. We then device a mechanism to calculate the deviation in transfer functions and finally we plan to propose an algorithm to efficiently identify any potential malfunctioning device in the power network. The proposed algorithm will be evaluated on various tree and bus structured network; specifically we will use the IEEE standard test networks for our simulations.

1.5 Conclusion

Power quality meters play an important role in the reliability of power networks. We plan to investigate the problem of identifying devices that degrade the power quality in the system. The proposed solution will be built on top of our already proposed work.