Scoliosis is a pathological curvature of the spine which affects a few percent of the population. The curvature tends to develop throughout growth. Therefore regular monitoring is important to make sure the disease begin to cause health problems. For years, the gold-standard approach to this has been   
X-raying the back, and measuring the Cobb angle, the greatest angle between the end-plates of any two vertebrae. As you might expect, regularly X-raying adolescents creates health risks. This has motivated research into the use of spatially tracked ultrasound as a means to quantify the disease.

A number of preliminary studies have been done to assess the accuracy and validity of using tracked ultrasound. They consist of finding, and placing points at anatomic landmarks. Curvatures are computed from these points’ locations, and compared to the curvature measured in X-ray. Regardless of whether these studies have been done on phantom models, or living patients, I suspect that their landmark data is somewhat idealized.

Apparently validation work has only been done on mild to moderate cases of scoliosis, Cobb angles mostly up to 45o. There are also idealizations associated with using phantom models, and wide-range transducer setups. Some of these authors themselves acknowledge being unable to locate anatomic landmarks in some difficult cases. With some cases of scoliosis being far worse than 45o, and other difficulties in using ultrasound, a reliable, robust means of quantification is required.

That is why I am investigating the applicability of neural networks to the problem. Neural networks are known for their robustness and accuracy, indispensable virtues in clinical settings. I have 124 sets of scoliotic patients’ transverse processes located from CT-derived models, ranging from mild to severe. The accuracy of CT makes this a natural ground-truth from which to extract the correct curvature. I will then programmatically degrade the data, introducing errors expected in ultrasound data: noise, missing points, and misplaced points. A sufficient pre-processing module will be used to repair the data sets so they can be used to train a neural network.

The network will be presented with the landmarks locations, and its output compared to the ‘correct’ angle. The network will be trained on the basis of the difference between its output and the correct value. After training, it will be tested on new landmarks sets, and its error will be investigated. I will do this for various combinations of experimental parameters; I will vary the amounts of input data error, use different training set sizes, networks architectures and functionalities, etc.… With the results of these experiments, I hope to demonstrate that the method produces curvature estimates comparable to those of current studies, and within clinically acceptable limits of error, for ranges of parameters.