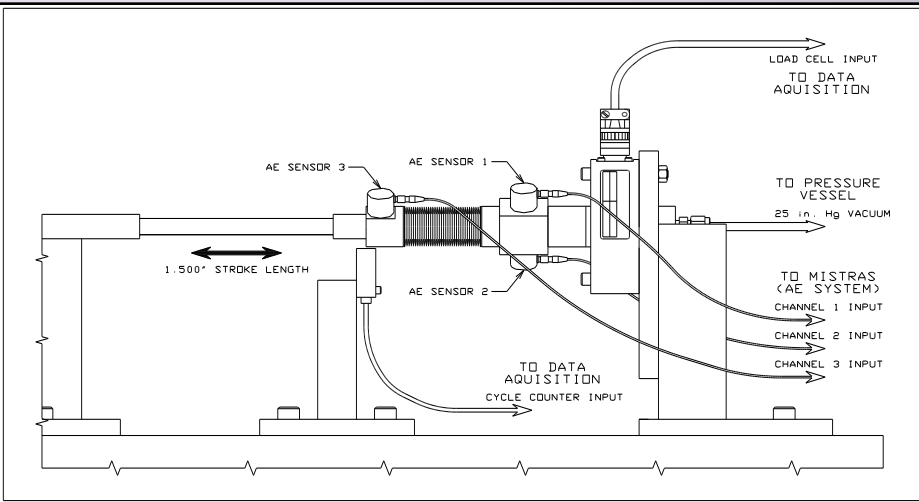


Aerospace Bellows Neural Network Fatigue Life Prediction

Eric v. K. Hill and David L. W. Ballard



Experimental Bellows Fatigue Setup

OBJECTIVES

- Back-propagation neural network (BPNN) prediction of bellows cycle life from acoustic emission (AE) data gathered during **early cyclic loading – first 10-15% of cyclic life**
- Two material types with seven specimens each: 350 stainless steel and Inconel 718 nickel alloy
- **Goal:** Predict bellows cycle life with worst case prediction error within **±5%**

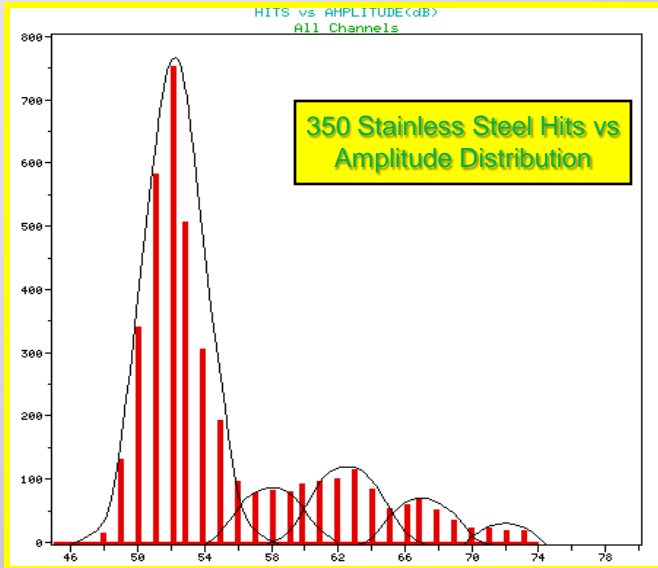
APPROACH/TECHNICAL CHALLENGES

- Use first 250 AE signals (hits) from fatigue cycling
- Train BPNN using amplitude distribution histogram (hits for each amplitude from 50-100 dB) as input: five 350 stainless steel and four Inconel 718 specimens
- Test BPNN on two remaining 350 stainless and three remaining Inconel 718 specimens

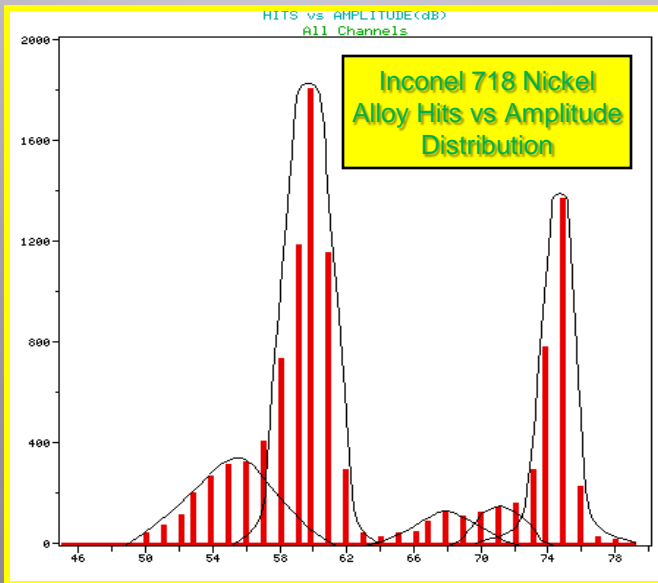
ACCOMPLISHMENTS/RESULTS

- **Worst case prediction errors: 2.66% for 350 stainless steel and -4.45% for Inconel 718**

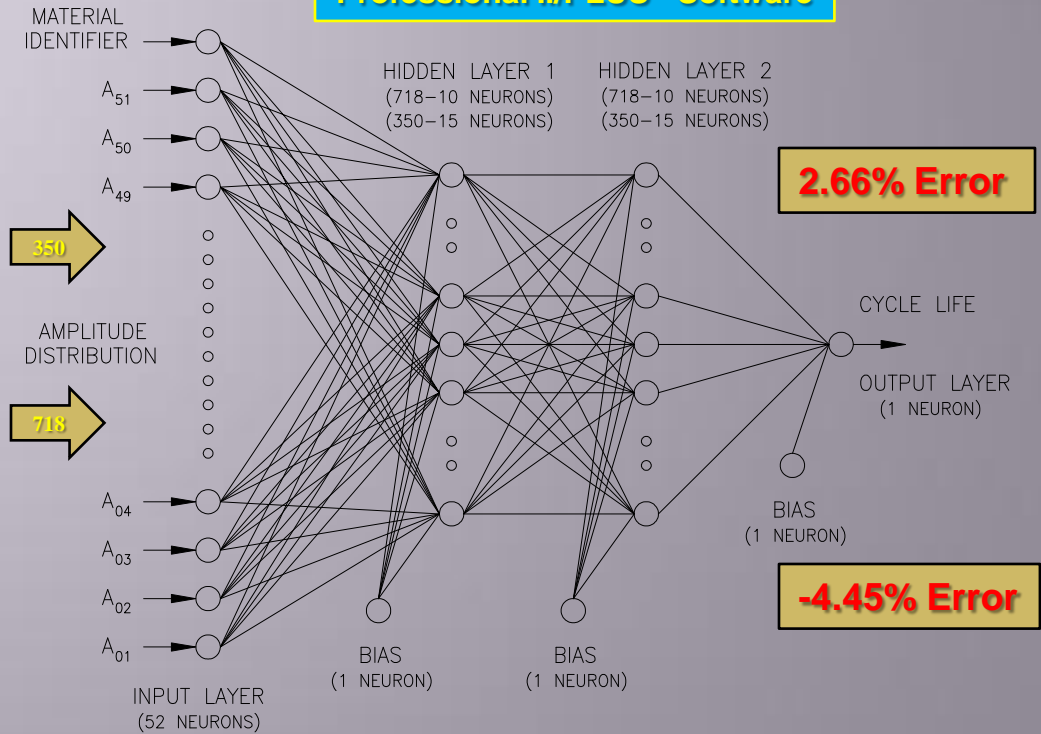
Back-Propagation Neural Network for Predicting Fatigue Cycle Life



AE Histograms for First 10-15% of Cyclic Life



NeuralWorks Professional II/PLUS® Software



**First Hidden Layer : Classification
Second Hidden Layer : Prediction**