Chapter 7

Conclusion

In the present research, a step-up advancement is made in the area of NDT based structural health monitoring. The initial section of the study presents FOS integrated with neural network methodology for strain prediction under static and dynamic loading. The later sections include damage location prediction using optical parameters integrated with neural network technology. The present work also includes the damage analysis using a wavelet-based diffuse wave technique. Under this study, analysis is performed based on an integrated neural network approach and a new wavelet-based residual energy method.

The originality of the present study lies in the integration of the neural network technology approach with FOS parameters and diffuse wave-based wavelet parameters. In the case of the FOS approach, optical parameters are used as input parameters for the developed network model, and strain values are predicted under static and dynamic loading. A similar approach is used for the location of damage in the cantilever beam. In the diffuse wave field analysis, the wavelet coefficients have been used as input for the network model to obtain the damage location in the structure. Wavelet-based residual energy is obtained for the diffuse zone, which is used for the prediction of the severity of damage present in the structure.

The following section outlines the novelty of the contribution of the present study in the area of SHM. The conclusions drawn from the study and future possibilities are also discussed in detail.

7.1. Research Conclusions

This research work contributes to two non-destructive testing areas of SHM. The first area includes the use of FOS integrated with neural network technology for strain detection and damage location. The second area focuses on diffuse wave analysis.

The Major outcome of the research work is summarized as follows:

1) A new SHM technique based on the neural network using FOS parameters has been developed. A successful demonstration of the technique is proved by output approximation of strain results made by the proposed neural network model. Results are obtained for both static and dynamic loadings.
2) Using the frequency domain optical parameter of FOS, damage location analysis is performed by defining the neural network model.
3) In the diffuse field area, a sincere effort is made to develop a novel method of diffuse zone selection using the wavelet transform.
4) A neural network model using diffuse wave-based wavelet parameters for damage assessment methodology is proposed, which successfully determines the location of the damage in the structure.
5) A novel wavelet-based damage analysis methodology using a diffuse wave is developed. In this method, residual energy is determined to co-relate the level of damage in the structure.

The proposed approach can be successfully applied for on-line health monitoring of structures. Signature of FOS signals can be directly used for feeding the neural network to obtain the structural measurement parameters. Damage assessment can be performed under both static and dynamic loading conditions. This study focus on

development of a method for the detection of diffuse zone in a signal based on wavelet analysis. Advancement is made in developing a wavelet based residual energy concept for analyzing the severity of damage present in a structure. Results of the work successfully correlates with the pre-existing methodology. Continuous structural health monitoring can be made using the proposed technique. Present research can be helpful in understanding the structural behavior under different loading conditions.

7.2. Recommendations for Future Work

Possibility of expansion in any research work, open new areas to explore and contribute. The research work presented here can be further extended as follows:

1) A logical expansion of a designed neural network can be executed using a convolute neural network (CNN) technology.
2) Various other neural architectures can be tried and tested for obtaining better output and a low degree of error.
3) Long term study of different algorithms can be tested for advanced structural health monitoring.
4) Diffuse wave is an emerging area that carries much potential yet to be explored for SHM.
5) Future studies may focus on analyzing the variation in the geometry and the type of structure other than the cantilever.
6) Wireless technology can also be introduced and implemented as an advancement in FOS and diffuse wave-based SHM.