Part V
Signal Processing

Abstract The previous parts of the book at hand deal mainly with the basics of guided waves in thin-walled structures. Isotropic as well as anisotropic and layered material is considered and the governing equations are formulated. This analytical approach is essential for the understanding of the physical phenomena, however, not sufficient for the analysis of engineering structures. Therefore, numerical and experimental methods for the analysis and observation of wave propagation are presented also.

For the design of Structural Health Monitoring systems, additional technologies have to be considered, especially signal processing. This means that sensor data have to be captured and to be processed for damage detection and localization. This is the main concern of this part of the book.

Therefore, the next chapter deals with the detection of impacts and the localization of impact events in anisotropic plates by a sensor network. The methodology developed is additionally applied to the localization of existing structural damage, such as delaminations. In damage localization algorithms the exact time-of-flight determination plays a crucial role. So another chapter deals with this important subject and discusses techniques especially for complex structures.

Dispersion diagrams play also a fundamental role in the design of Structural Health Monitoring systems. If the material parameters are not exactly known, experimental methods come into play. In the following chapter, the matrix pencil method is presented which aims at automatically extracting dispersion curves from laser vibrometer measurement data in an easy and robust manner.

Finally, the last chapter in this part of the book deals with damage identification by dynamic load monitoring. The method relies on the idea that the difference of the wave fields in the undamaged and damaged structure is caused by a virtual external force which can be interpreted as the source of altered wave properties. The implementation of the method and its numerical performance is shown.