CHAPTER TWO
LITERATURE REVIEW

Very few techniques other than ESDM have been developed which use spatially dense, experimental dynamic response data to reconstruct three-dimensional, structural dynamic response fields. Moreover, unlike ESDM, these techniques only reconstruct dynamic response at discrete structure points and do not yield an explicit, continuous response field. However, the techniques that have been developed use significantly different approaches than ESDM. Hence, a discussion of such techniques ultimately aids an understanding of ESDM. This chapter briefly explains some of these techniques.

Dominguez [7] developed a technique which reconstructs three-dimensional, translational velocity response fields at selected structure locations by regressing velocity data obtained from a scanning LDV. Specifically, his technique regresses spatially dense velocity data sets obtained from two-dimensional LDV scans at different LDV positions. The regressions are based upon polynomials and each regression is referred to a common coordinate system. Each regression yields an expression which relates velocity magnitude and structural location. Each expression is then evaluated at the same structure points. The points chosen are completely arbitrary; however, at least three points are required. This step yields a set of velocity magnitudes at each selected point. The velocity magnitudes at a selected point are actually projections of the true velocity magnitude at the same point. Since the directions of the projections are known in the common coordinate system, a set of linear equations at each point is developed which relate the components of the true velocity magnitude to each of the projected magnitudes.

The only unknown terms in the resulting equations at each point are the true velocity magnitude components. The linear equations at each point are assembled into a matrix equation and solved, thereby yielding estimates of the true velocity vector components at the selected points. Unlike ESDM, this technique does not explicitly yield a spatially continuous velocity field; therefore, the derivation of other dynamic response fields, including acceleration, displacement, strain and stress fields, is impossible. However, it implicitly yields a spatially continuous velocity field since the structure points at which the regression expressions and resulting matrix equations are evaluated are entirely arbitrary. As with ESDM, this technique retains all phase information since harmonic time-series regression of the velocity data obtained from each scan is also performed.

As Montgomery indicates [8], other researchers have also reconstructed velocity response fields by regressing velocity data obtained from a LDV or employing holographic techniques. However, these efforts are restricted to at most two-dimensions. Still other researchers, including Donovan [9], have measured three-dimensional velocity response with an LDV at selected locations. Unfortunately, such efforts yield results only at discrete structure locations. Currently, ESDM is the only method which 1) directly yields three-dimensional, continuous velocity fields from LDV data and 2) permits the mathematical derivation of other dynamic response fields.