CHAPTER V

ANALYSIS OF EXPERIMENTAL DATA

The analysis used for a systematic reduction of the experimental data is considered in this chapter. Determination of the applied magnetic field is discussed first. Next is the calculation required to estimate the state of strain in the magnetic sample from the directly measured mechanical parameters. Following this is the technique used to consistently determine the state of magnetization in the shocked ferromagnet from the actual induced emf oscilloscope records. Lastly, the experimental data resulting from this work are presented.

5.1. Magnetic Field

As was discussed in Section 4.1, the magnetic field is determined by monitoring the voltage drop across a 1Ω, 1%, 5 watt resistor. This resistor, being in series with the solenoid, realizes the same current which is obtained from the voltage record through the relation

$$I = V\left(\frac{1}{R} + \frac{1}{Z}\right). \tag{5.1}$$

Z is the characteristic impedance of the monitoring cable and R is the 1Ω resistor. The applied field is in turn obtained from

$$H_e = 0.4\pi NI.$$

These two equations provided the recorded values for the magnetic field. The corrections due to demagnetizing and finite inductance effects were not made.

They were canceling corrections and at best 2% corrections individually. Consideration of errors incurred by measuring R and N along with the associated voltage and calibration records gave an rms error in determining H_e of $\pm$ 2%.

5.2. Uniaxial Strain Field

The primary method used to calculate the state of strain in the YIG was through equation of state knowledge of the intermediate materials and measured projectile velocities. The necessary equations of state were presented in Section 4.2.2. The experimental procedure required creation of the same state of strain over a series of shots. The ability to do this relied on the reproducibility of the projectile velocity. It was found that the projectile velocity was constant within 1% over a series of shots. In this analysis, the average projectile velocity was assumed for the entire series.

Calculation of the state of strain in the YIG proceeds as follows. Upon impact of the projectile, the initial state (P', u', and η') behind the initial shock in the Lucite is obtained from requirements of continuous P' and u' across the projectile-Lucite interface. Simultaneous solution of the projectile $P - u$ relation and the Lucite $P - u$ relation (Equation (4.4)) gives P' and u'. Equation (4.8) can then be solved for η'. This is the reference state for the recentered Hugoniot which is used to obtain the state behind the shock reflected from the YIG-Lucite interface. The state of strain in the YIG requires simultaneous solution of the system of equations

$$P = \frac{\left[\frac{\Gamma_o}{2} P'\eta + P_H^o(\eta)\left(1 - \frac{\Gamma_o}{2}\eta\right)\right]}{1 - \frac{\Gamma_o}{2}(\eta - \eta')} \qquad (5.2)$$