Chapter 6: Conclusions and Future Direction

6.1 Conclusions

Various conclusions can be drawn from the observations presented in the previous chapter. As can be seen from the magnetic field response of the sensors, the sensitivity to external applied magnetic field depends greatly on the operating point of the sensor. Only if the sensor operates around the middle of the fringe and has a small variation about the operating point, can the output be assumed to be almost linear. However, if two sensors with a 90^o phase shift are used with the quadrature phase shifted (QPS) EFPI signal demodulation scheme, then the overall output is, theoretically, proportional to the air gap change. But as can be seen from the calibration curves, this is not the case in practice. Several important factors may be the cause of this discrepancy, the primary reason being the two sensors of the pair not maintaining the quadrature relationship over the operating range. Temperature and strain are the main factors in this case. If the passive temperature compensation, currently used for the two sensors, is not same, the change in air gap due to temperature variation is different for the two sensors and hence they are no longer in quadrature. Similarly if the sensors are fabricated with different physical strains on the sensor elements, the air gap change on application of external magnetic field is not same and thus the 90^o phase difference between them is lost. The effect of both these factors is made unpredictable by the practical difficulties in fabricating the sensors. Since this is a manual operation, precise control of various parameters like gage length, tube length and epoxy spreading is extremely difficult.

6.2 Future Direction

Use of an active temperature compensation scheme to maintain the air gap length in the sensors could be one way to eliminate the effect of temperature variation on the system sensitivity. This could be done using an accurate temperature sensor for feedback and a piezo-electric material to actuate mechanical change in the air gap. If the drift in the sensor output with temperature is known, the data could be stored as a calibration table in the micro-processor based signal demodulation system and used periodically to refresh the value of the sensor reference output. If a stable sensor with a small drift around a constant operating point can be fabricated, then the signal demodulation system is further reduced to a simple calibration table and the need for two sensors is eliminated. Such a sensor system however, has to be highly temperature compensated. Strain-induced air gap length variation should also be eliminated in this sensor for accurate magnetic field measurement. Resolution of the magnetometer system can be further increased from the current 100 nT, by using an A/D converter with more number of bits than the current 12 bits.