The significant discovery of photosensitivity in optical fibers leads to the development of a new class of in-fiber component called the Fiber Gratings, a region of an optical fiber with a periodic structure of the refractive index, induced in the fiber core. The formation of such a permanent grating in the fiber core has revolutionized the telecommunication and sensing technologies due to their intrinsic integration with fibers and the large number of device functionalities that they can facilitate such as filtering, chromatic dispersion compensation and gain flattening. The most distinguishing feature of the fiber gratings is its flexibility. This enables one to achieve the desired spectral characteristics by changing their physical parameters like grating periodicities. Therefore, Fiber Gratings are often classified into Fiber Bragg Gratings (FBGs) and Long Period Fiber Gratings (LPFGs) depending on the magnitude of the grating periodicities.

Coupling mechanisms of FBGs and LPFGs have certain fundamental differences. Fiber Bragg Gratings couple light from a guided core mode to counter propagating cladding modes satisfying phase matching condition and reflect back the light, whereas Long Period Fiber Gratings (LPFGs) couple light from a guided core mode to the co-propagating cladding modes satisfying phase matching conditions and cause it to be lost in the cladding.

Recently, Mechanically induced Long Period Fiber Gratings (MLPFGs) have drawn significant attention in a number of applications as they can easily be formed to produce similar filter functions to those of photosensitive and fused Long Period Fiber Gratings. MLPFGs are formed by applying periodic pressure on an optical fiber that induces a periodic change of refractive index, via, elasto-optic
effects. When one applies periodic pressure along a fiber to fabricate an MLPFG, linear birefringence occurs in the MLPFG. Due to this birefringence, the fundamental eigen mode becomes degenerate, forming fast and slow modes exhibiting different effective indices. These two principal modes couple to cladding modes in an MLPFG at different but close wavelengths determined by the phase matching conditions. Therefore two transmission notches, appear as a single notch when an unpolarized source of light is used, depending on the elasto-optically induced refractive index change. Therefore MLPFGs are considered as important tools for the understanding of induced birefringence. The thesis is dedicated to the study of linear and circular birefringences induced through mechanical deformations such as lateral pressure, twist etc., using MLPFG.

The thesis is organized into seven chapters. **Chapter 1** gives a brief introduction to refracto and elasto-optic effects in single mode silica fibers. First section of the chapter reviews the properties, fabrication techniques and characteristics of LPFGs whereas the second section discusses different elasto-optic effects and corresponding elasto optic coefficients such as strain-optic coefficients, stress-optic and stress-optic rotation coefficients. The third section discusses some of the applications of LPFGs and their sensitivities with the parameters such as bending, external index modulation etc. **Chapter 2** deals with the experimental techniques used in the present study. The design and fabrication of an MLPFG with a loading system is described.

The study of lateral pressure induced linear birefringence in SM silica fibers using MLPFG is presented in **Chapter 3**. The transmission characteristics of the MLPFG depend on elasto-optically induced refractive index changes. The induced refractive indices modify the phase matching conditions and a wavelength shift of
resonance is observed in the transmission spectra with applied lateral pressures. The investigations are made for three different grating lengths (3 cm, 5 cm and 7 cm). The induced birefringence is measured for each case (for two different fibers) by measuring the resonant wavelength shifts with lateral load. The discrepancy in the measured values of induced birefringence with the theoretical values, beyond a certain value of lateral stress is due to the inherent limitations of micro bend based mode coupling. The broadening of spectral width of the transmission notches is also noticed as grating length is decreased.

Chapter 4 presents the study of twist induced circular birefringence in SM silica fibers using MLPFG. A Mechanically induced Long Period Grating is formed over a twisted fiber for the present investigation. The amplitude as well as the resonant wavelength shift is studied in response to the applied twist and pressures. These resonances decrease in amplitude and shift to shorter wavelength as the applied twist increase. Shearing stress causes the fiber to be circularly birefringent and modifies the effective indices of the modes in the optical fiber. This affects the phase matching condition and therefore the resonant notches shift towards shorter wavelength. The induced circular birefringence is measured for different twist rates using resonant wavelength shift and is detailed in the chapter. The spectral response of a grating assembly formed by two grating sections in series, one with a twist and other with an untwist are also investigated. This study establishes equal and uniform circular birefringences for all the cladding modes satisfying resonant conditions. The pressure-induced linear birefringence, one of the inherent limitations of micro-bender technology may be compensated by the introduction of twist induced circular birefringence.
Chapter 5 discusses the experimental realization of the measurement of stress-optic rotation coefficient from the twist induced resonant wavelength shifts. The observed shift in resonant wavelength towards shorter wavelength can be attributed to the induced circular birefringence in the cladding of the fiber due to the twist introduced. A graph is plotted between the measured values of twist induced circular birefringence $\delta n$ and twist rate $\phi$. The slope of $\delta n$ Vs. $\phi$ graph is a direct measure of the elasto-optic rotation coefficient $g$. Within the limit of experimental errors this method allows to evaluate the elasto-optic rotation constant ($g$ parameter) for various telecommunication fibers. Thus a novel, simple and direct method for determination of the elasto-optic constant for SM silica fibers is proposed.

Chapter 6 presents some of the applications of MLPFGs. The chapter proposes a novel multi-channel notch filter and a multi-point pressure sensor with a configuration of two or more identical MLPFGs in a row. The twist rates and lateral load with each grating section determines the spectral characteristics of the individual MLPFG. The chapter discusses the compensation of pressure induced linear birefringence, one of the inherent limitations of micro-bender technology by the introduction of twist induced circular birefringence. The study will be useful to realize such notch filters and pressure sensors.

Chapter 7 discusses the summary of the investigations and future scope of the results obtained from the present study.