Epilogue

There have been no other alternatives than to keep the final conclusion of this dissertation wide open. The inconclusiveness of the final conclusion stems from a valid reason. Perhaps, while travelling through the webs of patterns with or without defects in woven fabric, one may inclined to accept that there can be at least two varieties of realities when attempts are made to recognize and classify a defect. One may go a step further beyond the process of hardware recognition and classification of defects by computer and/or optoelectronic techniques, to the identification of defects by human visual system. The problem however, then turns beyond the realm of technological realities.

Some elaboration may be in order. From Plato through Decartes and Kant in the west, and Buddha, Patanjali through Sankaracharya in the east, have analyzed and tutored the aspects of realities centered round the perception, sensations, understanding, consciousness etc. Those are related to the mind and generally are beyond the scope of hardware of technologies. The other kind of realities is of course, those realized through technological tools and hardware.

There is a central issue involved in the discourse of mind-body problem in the context of defect detection. The question arises regarding the process involved by which brain - the material object of our body can evoke signals in our mind, which in turn may control many of our actions or inactions for detecting and perhaps eliminating a defect. This may inspire another useful curiosity in intelligent defect detection, which may go beyond the *hard* scientific or technological issues to the areas of reasoning and consciousness.

In the present dissertation, we have not touched upon the issues of realities of mind-body problem, but have explored the realities of second kind; those are much discussed and investigated under the realm of technology. We attempt to realize machines or more so the methodologies those can work and can detect deviation form regularities, in a limited sense of practical world. Incidentally, the presently practiced manual system of defect detection is one aspect of coordination between visual perception, intelligence and muscle action – an action of first kind. However, one should be conscious and accept that the two kinds of realities are interdependent- which means that there can be a correlation between the two. Perhaps a day is not far off when these questions would be addressed in the language of science and translated in the domain of technology.

In this dissertation, attempted have been made to develop few improved versions of methodologies those can be used for detection of defects in woven fabric. The motivation behind the effort is to use optoelectronics technologies when the implementation issues are addressed. Instrumentation processing system based on optoelectronics techniques undisputedly is one of the best candidate for such applications where increasing demand for high-speed detection and recognition of various defects are felt. Evidently, the computational requirements involve the need for parallel processing of information obtained from temporally / spatially varying scenes in real time. Since optical beams are inherently parallel and data can be presented in two dimensional and multidimensional forms in optical domain, optics / optoelectronics technology is ideally suited for these applications. The advent and wide exploitation of laser as coherent source along with the development of optoelectronic detecting devices such as CCD camera and light control devices such as spatial light modulators have paved the way further for the evolution of technologies based of optoelectronics principles.

There are three basic components in optoelectronics instrumentation for defect detection techniques. They are: (a) image acquisition, which transforms the intrinsic characteristics of textured pattern into electronically coded digital bit patterns by using laser based system (b) integrated image processing, where feature extraction, image analysis and recognition is carried out using suitable algorithm and (c) decision making, which decides about the attributes to be identified for categorization, classification etc.

The interlaced grating structure of weft and warp yarns provided a point to suggest and experiment with the diffraction patterns of woven fabric. It has been shown that certain parameters can be defined and measured from the diffraction pattern, deviation from which indicates the presence of a defect in the regular grating structure. The measurement is based on optoelectronic principles and provides a tool for simple instrumentation. Classification of defects is also possible. The technique though very simple may not be very accurate particularly when multiple defects are present in the field of view. Mixing of different types of defect may also trigger false classification. The requirement of visualization of the defect for classification leads to the use of optical imaging and spatial filtering technique. The basic grating structure is filtered out and the defects are identified in the visual field. However, the technique fails to support the demand of instrumentation where the question of on-line detection and classification is raised.

Joint transform correlation technique is therefore a logical alternative optoelectronic instrumentation. Since the technique has not yet been attempted for the detection of defects in woven fabric, the simulation of the technique modified suitable for such a situation is explored. It has been established that it is possible to evolve on-line defect detection system, which can provide correlation signals even in the presence of multiple defects in the field of view. Unfortunately, non-availability of the suitable light modulating system such as electrically addressed spatial light modulator for registering joint scene limits the practical realization of the technique evolved.

Though the JTC technique solves somewhat the problem of detection of multiple defects in the field of view, yet the visualization of the defects is not possible. A solution to the problem is provided by the use of morphological techniques and realization of the same by optoelectronic instrumentation. Attempt to improve the techniques leads to the use of spatial filtering procedure already evolved. Better results concerning the detection and visualization of defects are obtained when attempts are made to use rank order filtering.

The motivation for the evolution of pattern association formulations for defect detection mainly originates from the fact that human being is much better at defect recognition and classification than digital computer. However, there are enough reasons to consider certain problems by designing a naturally parallel system that will process information and will learn according to the guiding principles borrowed from biological system. This does not necessarily mean that there should be an attempt to copy the processing schedules in human memory, part for part. A naïve attempt has been made to establish a linear associator model for detection and classification of defects in woven fabric using the principle of minimum Hamming distance. The error need not be fed back, like other neural network models since corrective action in this case is not demanded. As a result, the information processing tasks of nearest neighbour search can be performed much more efficiently at a much higher computational rate through a process of parallel search operation.

The experiments suggested and carried out in this dissertation to prove and establish the developed principles though may be naive, yet those have been able to establish the validity of the proposals beyond reasonable doubts. It has to be mentioned and acknowledged with regrets that many improvements in establishing the optoelectronic instrumentation would have been possible had there been better experimental facilities. Such an improved situation is expected but is not presently available at this work place. Better experimental facilities would certainly support stronger convictions.

As an epilogue, it must be acknowledged that many issues have not answered or addressed. The logistic behind the correlation of realities of both kinds is conspicuously absent. We may quote from the aphoristic book "Tractatus Logico-Philosophius" by L. Wittgenstein, "what we cannot talk about we must pass over in silence."