

**Improvements of respiratory motion recording: optical belt vs pneumatic belt**

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**INTRODUCTION:**

Patient motions induce artifacts such as ghosting or blurring which can reduce MR image quality. To decrease the motion artifacts influence, several techniques have been used. One of the mostly used techniques in clinical examination is the synchronization with heart activity and respiratory motion which often necessitates patient cooperation [1]. An alternative to this technique consists in using a model motion based on prior knowledge provided by motion sensors [2]. The used (external or internal) motion sensors for this technique need to provide highly correlated information with internal organ motion. For respiratory motion, the most widely used sensor in clinical conditions is the pneumatic belt, which has the advantage of being non-magnetic and relatively inexpensive and which gives a well correlated signal with the position of the diaphragm [3]. However, they suffer from two main shortcomings: signal drifts and leaks. These drifts correspond to the high pass filter introduced either in the pneumatic part or in the electronic circuit to avoid saturation of system. Another explanation of this problem is the change in the position of belt on the patient during examination, mostly due to their shape. During the European project OFSETH (Optical Fiber Sensors Embedded into technical Textile for Healthcare) [4], an optical external sensor has been developed. This optical sensor in form of belt offers the advantage of being free from metallic or electrical conductive parts and unperturbed by the electromagnetic environment changes. In addition, the signal obtained is an absolute measure and it has no voluntary drift. It has a linear sensitivity to longitudinal mechanical stresses. This sensor could be an alternative to the pneumatic belt.

**MATERIALS AND METHODS:**

The developed external sensor (Fig. 1) is based on an optical fiber Bragg grating sensor (FBG) [5] which is characterized by a good sensitivity. This component realizes a UV (Ultra Violet) interferometry pattern. It reflects the Bragg wavelength and transmits all other wavelengths. With this kind of filter, a strain applied to the elastic part of the FBG realizes a UV (Ultra Violet) interferometry pattern. It reflects the Bragg wavelength and transmits all other wavelengths. With this kind of filter, a strain applied to the elastic part of the FBG allows the extraction of a local deformation in elastic tissue.

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**RESULTS:**

A snapshot of results obtained on phantoms and on volunteers is presented in Fig. 3. It illustrates a comparison between the signal from optical belt (Optical belt) and signal from pneumatic bellow (Pneumatic belt). For phantoms the internal displacement signals extracted from the image series (A-P motion) is also compared with optical belt. These results are also quantitatively compared in terms of correlation coefficients given in Error! Reference source not found. For phantoms, the results are given by averaging five SSFP sequences. For each volunteer, an average of three different deep breathings and two breath holds was used.

**CONCLUSION:**

This work demonstrates the feasibility of measuring respiratory motion with an optical belt based on an FBG sensor. The proposed sensor can correct the disadvantages of the pneumatic belt, particularly for breath-hold. In addition, the used of FBG sensors offers the possibility of measuring a local deformation in different points which could be used in revised algorithm [7].

**REFERENCES:**


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**Table 1 : Absolute value of correlation coefficient between optical and pneumatic belts a) on phantoms and b) on volunteers**

It can be shown from table results that the optical belt is well correlated to the results from pneumatic belts, which gives the same motion information. Moreover, it can be seen from Fig. 3 that the optical belt has no drift during breath hold. For the subject number 3, a difference between the two belts appears. In its current form, the optical belt is not well suitable for volunteers who have a low waist because of the used fixation system. This issue will be solved in new releases of the optical bellow.

**Conclusions:**

This work demonstrates the feasibility of measuring respiratory motion with an optical belt based on an FBG sensor. The proposed sensor can correct the disadvantages of the pneumatic belt, particularly for breath-hold. In addition, the use of FBG sensors offers the possibility of measuring a local deformation in different points which could be used in revised algorithm [7].

**References:**