

Bio-radiolocation Method at Chest Wall Motion Analysis during Tidal Breathing

D. A. Korchagina^{#1}, M. D. Alekhin^{#2}, L. N. Anishchenko^{#3}

[#] *Bauman Moscow State Technical University
2nd Baumanskaya, 5, 105005, Moscow, Russia*

¹dkorchagina@rslab.ru

²alexmxmakc@narod.ru

³anishchenko@rslab.ru

Abstract— Influence of chest wall surface motion in bio-radar signal during tidal breathing was researched. A high-speed camera and multi-frequency radar with signal step modulation were simultaneously applied. The model of chest motion during quite breathing was used. Pairwise correlation coefficients for all the markers on the chest wall given in the model were calculated. The correlation of data from high-speed camera and bio-radar was found. Two methods were compared.

I. INTRODUCTION

Nowadays there is enough number of techniques to measure lung volume and airflow at entrance into human respiratory tract. They have acquired a good reputation and are widely adopted in medico biological practice [1].

However, the question of describing a motion of chest surface as well as abdominal area during quiet breath is still open. There has been no adequate mathematical model created so far which would reflect with enough precision a pattern of movement of specific points on chest surface and its fluctuation. Therefore, usage of new research methods in this field is an actual scientific problem.

II. MATERIALS AND METHODS

In this study bio-radiolocation method was used. This method enables to detect presence and conduct diagnostics of a human remotely, also behind optically non-transparent obstacles. Bio-radiolocation is based on modulation of radar signal by oscillatory movements of human organs ([2]-[4]). Signals reflected from human body obtain specific biometric modulation that is not present after reflection from motionless objects. The initial cause of biometric modulation presence in reflected radar signal is heartbeat, contractions of vessels, lungs and other organs and especially oscillatory movements of cutaneous integument in chest area [4].

Results obtained previously with participation of a large experimental group using method of electro optical plethysmography [5] were taken as experimental model for this research. As a result of experimental data processing, the spatial vectors of movement of markers placed on chest surface of each subject during quiet breathing were obtained and kinematic model of this process was proposed. The scheme of markers disposition on chest surface is shown on fig.1. The averaged horizontal plan projections of movement

vectors of markers are known from the work [5]. This gives an opportunity to change from frontal markers movements relative to a certain central axis to the movements in the chest-back direction.

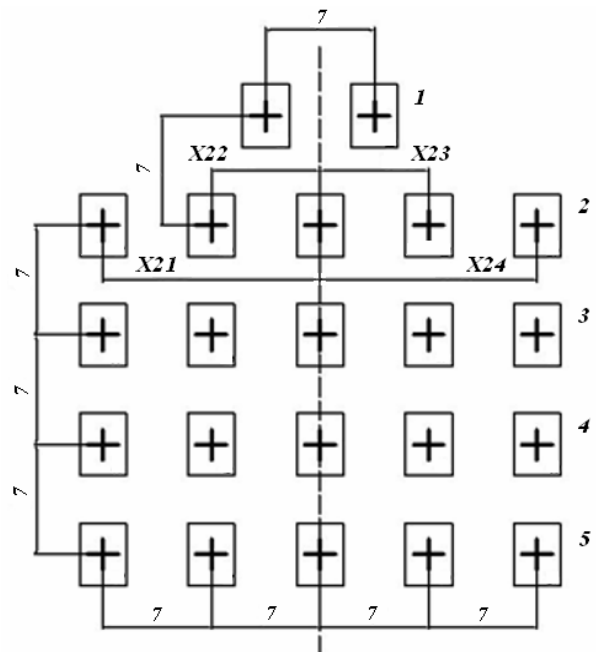


Fig. 1 The location of markers on chest surface

The main principle of usage of high-speed camera method is based on the following. Cross-shaped markers were placed on chest surface in disposition corresponding to the position of markers in the model of chest motion during quite breathing [5]. It was assumed that the motion of markers during breathing accomplished in direction of averaged vectors given in this model. It was also known that camera was making 6.5 frames per second in selected mode. Thereby, knowing changes of distances from the markers to central axis in frontal plane it was possible to plot time dependence of markers movements in direction of photo camera lens. That was necessary for further analysis and comparison with data received by bio-radiolocation method. One of obtained pictures is shown on fig. 2.