

# The "In Plane" Visualization of the Breathing Movements of Chest and Abdomen Wall *(no. p44)*

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- **Form:** Poster
- **Category:** Basic Science
- **Topic:** Breathing

The standard image processing tools were used for the evaluation of the breathing movements in deep breathing. SpeedSence 9060 camera, resolution 1280x800 pixs, 25 frames/s was used for "in plane" recording (opposite to the chest and abdomen). Firstly the images of the video sequence were sharpened by means of a Laplacian filter in order to highlight surface patterns (the shirt with checked pattern). Sharpened consecutive images were analyzed by the cross-correlation tool of DANTEC Dynamic Studio (segments 64x64 pixs). Resulted matrices of moving vectors for given breathing maneuver were analyzed in MATLAB and their average, maximal and standard deviation values were displayed for interpretation of movement. The sum of consecutive movement vectors displays whole trajectory of body parts.

## Results

Cross correlation of images at the beginning and end of movement shows overall movement vectors but analysis of consecutive images refers to the dynamics of breathing movement as the trajectory and speed of different parts of body.

The results show the dominant horizontal movement of abdominal wall in the place of navel in the case of deep breathing with prevalence of abdominal movement. The dynamics of the movement reveals the quick sternal downward movement at the beginning and widening of lower rib cage part at the end of inhalation.

The deep pectoral breathing shows the main horizontal movement in the lower lateral part of the rib cage and whole chest vertical movement. Dynamics of the chest demonstrate the hysteretic movement.

The combined deep breathing reveals combination of the above mentioned movements.

The image analysis of video recordings of breathing movements could be a useful tool for description of breathing patterns in speech and singing.

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