

# Peak Strain Dispersion

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## Introduction

Automated Functional Imaging (AFI) exploits speckle tracking echocardiography to allow quantitative assessment of Left Ventricular (LV) function. The tool provides the user with capabilities to track “natural acoustic markers” in the myocardial tissue in any direction within the tracking plane throughout the heart cycle.

GE Healthcare has, through a series of breakthroughs, continued to lead the development of quantitative ultrasound-based technologies. Recently, a new index to evaluate ventricular dyssynchrony was introduced.

## Peak Strain Dispersion

In a healthy heart, the contraction of each myocardial segment will occur in synchrony (see Figure 1). This means that the time-to-peak longitudinal strain for each segment would be similar in a healthy individual. Strain traces for a heart with high mechanical dispersion is shown in Figure 2.

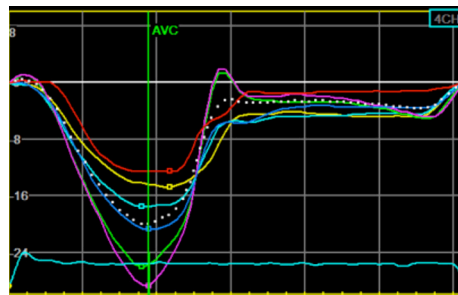


Figure 1. Example of strain traces from a patient with a normal contraction pattern

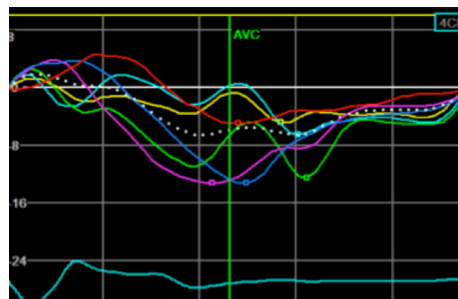


Figure 2. An example of patient with high Mechanical Dispersion (PSD). The strain peaks are dispersed and some initial segmental stretch can be appreciated.

AFI can show a time-to-peak bull’s-eye and calculate the PSD (Peak Strain Dispersion) index. This index can mathematically be defined as follows:

$$PSD = \sqrt{\frac{1}{N-1} \sum_{i=1}^{i=N} (TTPSL\_seg_i - TTPSL\_avg)^2}$$

In other words, the standard deviation of the time-to-peak longitudinal strain for each segment. This index is calculated after the strain analyses of three apical views have been completed. The index is shown in the bull’s-eye view and gives an indication of the dispersion of time-to-peak for all approved segments (Figure 3).

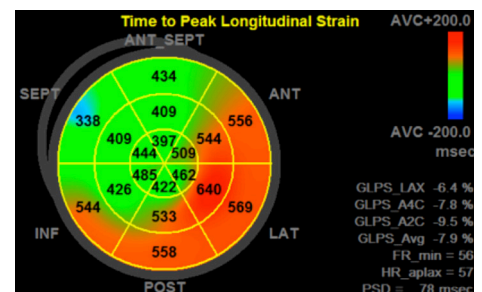


Figure 3. The PSD index can be found next to the bull’s-eye view when the time-to-peak (TTP) color map is selected.



## What segments to include?

AFI evaluates the tracking quality at each myocardial location over time, and suggests each segment as either “acceptable” (V) or “non-acceptable” (X) in a table just below the image.

Segment	basInf	midInf	apInf	apAnt	midAnt	basAnt	•
	✓	✓	✓	✓	✓	✗	Approve

Visual assessment of the tracking is important to consider if the automated evaluation of the tracking quality is valid for each segment. Based on this user assessment, the acceptance settings may be overridden. If more than one segment in any view is scored to be “non-acceptable”, the PSD index will not be calculated. A

re-definition of the Region of Interest (ROI) may be necessary to improve the tracking.

After approving the tracking, the strain traces will appear. Obvious non-physiological strain traces could negatively impact the clinical usefulness of the PSD index. The user should thus assess the quality of the strain traces by considering the following questions:

- Are there peaks in very early systole? (i.e. earlier than 100ms after peak R-wave)
- Are there peaks in very late diastole? (i.e. later than 200ms before Q-wave)
- Are there other obviously incorrect peaks that have to be artifacts?

If the answer to any of these questions is “yes”, the user should either reject the segments in question or redefine the ROI to possibly improve the tracking result. Rejection can be done from the “BE + traces screen” by using the menu-button (right-click on EchoPAC™) over the segment in the bull’s-eye (see Figure 4).

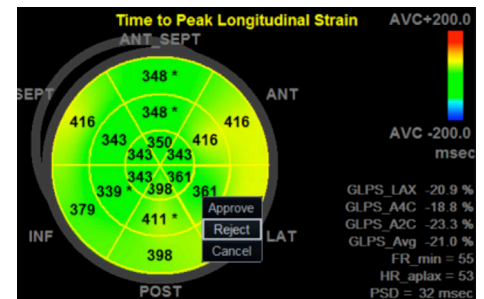


Figure 4. Clicking the menu-button over a segment brings up a small pop-up menu, allowing the user to approve or reject the tracking result of a segment.

## Imagination at work

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Note: The patent US8626279 B2 by Edvardsen, Haugaa and Amliie describes a method to predict risk and evaluate candidates for ICD therapy using Mechanical Dispersion. GE does not advocate doctors to practice the teachings of this patent, but has taken a license to hold doctors in the United States who do harm-free against any infringement claims.

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