Introduction

One of the most important elements in the cardiologist’s clinical routines is to get precise assessment of cardiac kinetics. This assessment is done by means of a combination of standard measurements like LV EF, Volumes, myocardial velocities etc. and qualitative evaluations that contribute to the final diagnosis.

At Esaote we are striving to provide truly innovative solutions to assist the cardiologist in achieving the most accurate and immediate diagnosis.
Chambers quantification
The modern approach in echocardiography includes basic and advanced modalities to help to increase diagnostic confidence.
**Systolic & diastolic function**

The modern approach in echocardiography includes different basic and advanced modalities that helps to increase diagnostic confidence.
Hemodynamics & valve assessment
The modern approach in echocardiography includes different basic and advanced modalities that helps to increase diagnostic confidence.
Wall motion score analysis

The modern approach in echocardiography includes different basic and advanced modalities that helps to increase diagnostic confidence.
Cardiac Mechanics

Echocardiographic imaging is ideally suited for the evaluation of cardiac mechanics because of its intrinsically dynamic nature.

Two techniques have dominated the research arena of echocardiography:
1. Doppler-based tissue velocity mapping
2. Speckle tracking on the basis of displacement measurements.

In systole, there is longitudinal shortening, transmural (Radial) thickening and circumferential shortening.

**Tissue Velocity Mapping (TVM)**

Tissue Doppler velocity estimation is based on the same principles as pulsed-wave and color Doppler echocardiography for blood flow. The major strength of DTI is that it is readily available and allows objective quantitative evaluation of local myocardial dynamics. The major weakness of DTI is its angle dependency, as any Doppler-based methodology can by definition only measure velocities along the ultrasound beam, while velocity components perpendicular to the beam remain undetected.

![Tissue velocity mapping approach (doppler based method)](http://folk.ntnu.no/stoylen/strainrate)
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Tissue velocity mapping approach (doppler based method)
Speckle Tracking Echocardiography

STE is a largely angle-independent technique used for the evaluation of myocardial function. Blocks or kernels of speckles can be tracked from frame to frame and provides local displacement information, from which parameters of myocardial function such as velocity, strain, and strain rate can be derived. STE has the advantage of being able to measure this motion in any direction within the image plane (longitudinal, radial and circumferential components).

Speckle tracking method (2D STE)

Click to enlarge
Speckle Tracking Echocardiography

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Incremental diagnostic yield in echocardiography
**XStrain**

An angle-independent imaging method to estimate and quantify endocardial velocities of contraction and relaxation, and estimate and quantify local deformation of the heart (strain and strain rate).

Regional myocardial strain rate and strain can detect inducible ischemia at earlier stages than visual estimation of wall motion or wall thickening parameters.

In the heart, the usual directions are longitudinal, transmural and circumferential as shown to the left.

The cylinder shows strain (compression along its long axis), which can be described as Lagrangian strain from $L_0$ to $L$. However, the figure also shows simultaneous thickening or expansion in the two transverse directions.

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Clinical outcomes of XStrain

- Segmental values of different parameters (velocity, strain, strain rate, displacement)
- Longitudinal, circumferential, and radial assessment of the heart’s wall motion
- Time analysis to identify desynchronization and perform CRT
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Circumferential strain/strain rate
Clinical outcomes of XStrain

- Segmental values of different parameters (velocity, strain, strain rate, displacement)
- Longitudinal, circumferential, and radial assessment of the heart’s wall motion
- Time analysis to identify desynchronization and perform CRT

Automatic Time to Peak calculation, suited for pre and post CRT procedures
Advantages of XStrain

- Precise quantification of all kinetics-related parameters and objective diagnoses
- Global representation of segmental values to quickly identify regional defects and perform reliable follow up
- Totally integrated in the patient report

Global strain values
Advantages of XStrain

- Precise quantification of all kinetics related parameter and objective diagnosis
- Global representation of segmental values to quickly identify regional defects and perform easily follow-up
- Totally integrated in the patient report

Parametric image & auto calculation
Advantages of XStrain

- Precise quantification of all kinetics related parameter and objective diagnosis
- Global representation of segmental values to quickly identify regional defects and perform easily follow-up
- Totally integrated in the patient report
XStrain 4D

XStrain 4D is a brand new technology which provides a volumetric model of the heart’s function by combining 2D apical planes acquisition using a standard transducer.

XStrain 4D improves diagnostic quality and can easily be incorporated into the daily routine.
Clinical outcomes of XStrain 4D

- Overall assessment of the LV function and quantification of the Global parameters like Strain/Strain rate, velocities, volume, segmental displacement and time to peak.
- Volumetric rendering including segmental values and bull’s eye representation
- Detailed systolic and diastolic analysis of any single segment based on specific graphs

Longitudinal strain
Clinical outcomes of XStrain 4D

• Overall assessment of the LV function and quantification of the Global parameters like Strain/Strain rate, velocities, volume, segmental displacement and time to peak.

• Volumetric rendering including segmental values and bull’s eye representation

• Systolic and diastolic detailed analysis of any single segment of any single segment based on dedicated graphs
Clinical outcomes of XStrain 4D

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Longitudinal velocity

Click to enlarge
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Strain rate
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- Volumetric rendering including segmental values and bull’s eye representation
- Systolic and diastolic detailed analysis of any single segment of any single segment based on dedicated graphs
Advantages of XStrain 4D

- Simplifies the overall data interpretation making the final diagnosis quicker
- Works with a very high temporal resolution
- No need for expensive special probes or special image acquisition training
- Based on the acquisition of the standard apical echo planes

The principle of Bull’s eye projection (Left Ventricle)
Reproduced with permission from: http://folk.ntnu.no/stoylen/strainrate
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3D assessment of the myocardial velocities
Advantages of XStrain 4D

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- Based on the acquisition of the standard apical echo planes
Advantages of XStrain 4D

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LCX coronary territory
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XStrain 4D Dedicated report
Advantages of XStrain 4D

- Simplifies the overall data interpretation making the final diagnosis quicker
- Works with a very high temporal resolution
- No need of expensive tools and special training
- Based on the acquisition of the standard apical echo planes
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