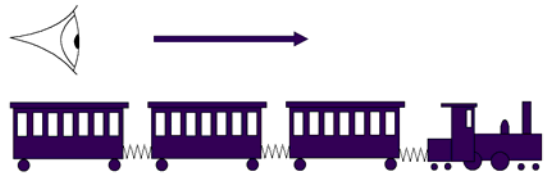


Grunnbegreper i Strain og Strain rate Imaging

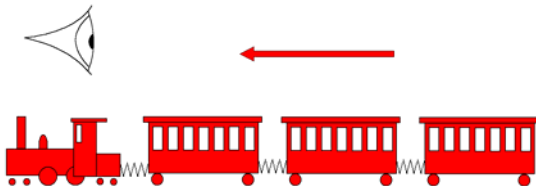
Myokardial deformasjon og bevegelsesavbildning med Doppler ultralyd.

Asbjørn Støylen

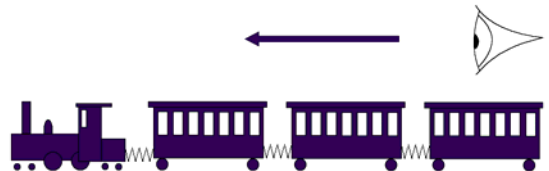
Hastighetsavbildning:



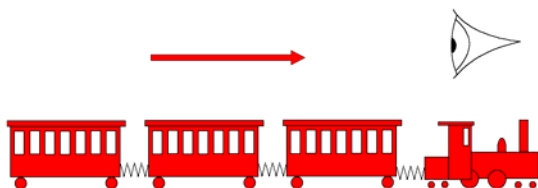
Hastighetsavbildning:



Hastighetsavbildning:



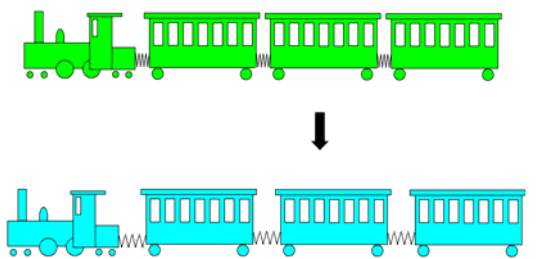
Hastighetsavbildning:



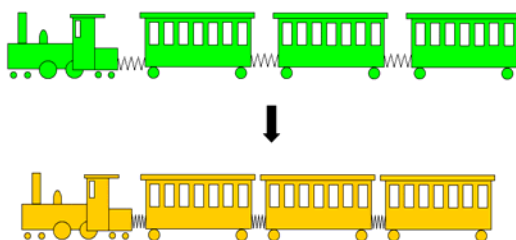
Bevegelse:

- Hastighet er bevegelse (motion).
- Hastighet over tid er forflytning (displacement) .
- Dersom hastigheten (bevegelsen) er lik i alle deler av objektet er det ingen deformasjon

Deformasjon - strekk:

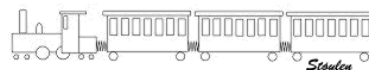


Deformasjon - forkortning:

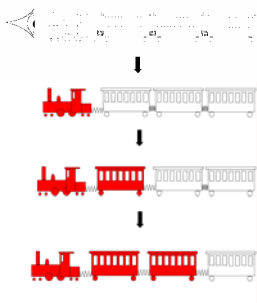


Deformasjon:

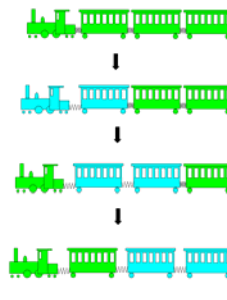
- Deformasjon (strain) er differensial forflytning innen objektet.
- Deformasjonshastighet er den hastigheten deformatjonen skjer med
- Deformasjonshastighet er differensielle hastigheter innen objektet



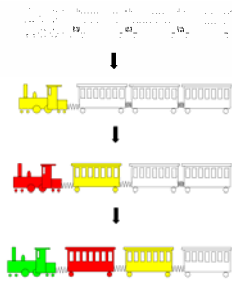
Hastighet:



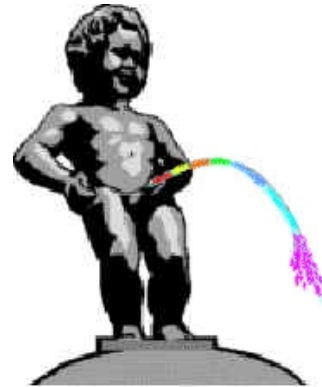
Deformasjon:



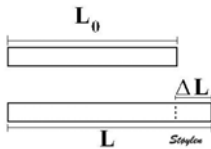
Forflytning:



displacement

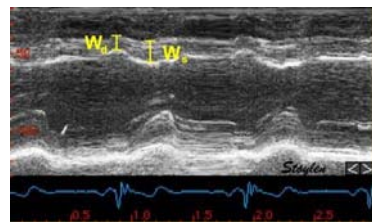


Lagrangian strain

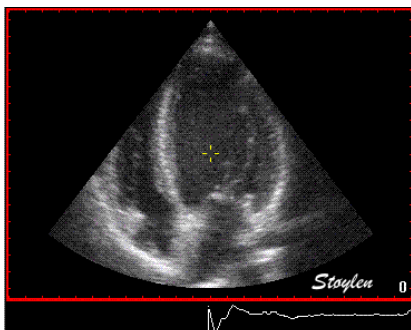


$$\varepsilon = \frac{L - L_0}{L_0} = \frac{\Delta L}{L_0}$$

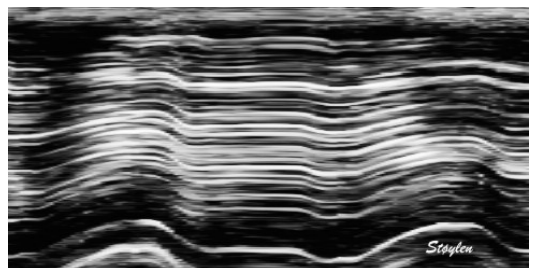
Veggfortykning:

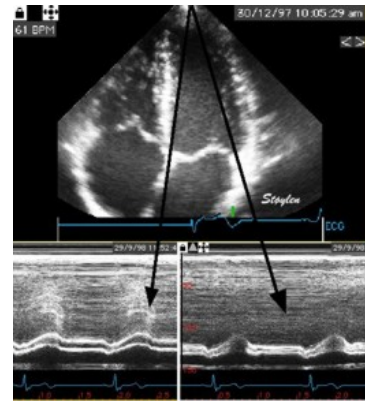
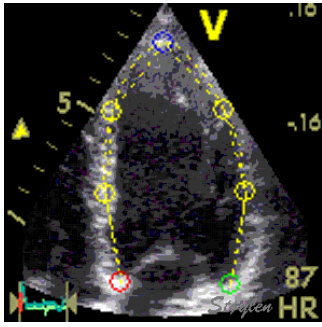


$$WT = \frac{W_d - W_s}{W_d} = \frac{\Delta W}{W_d}$$

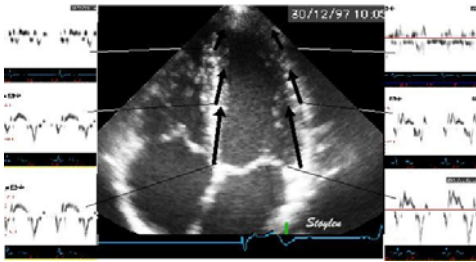


Longitudinell strain:

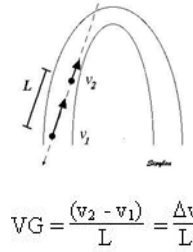




Longitudinelle hastigheter:

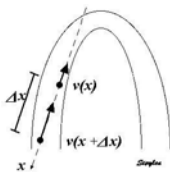


Hastighetsgradient:

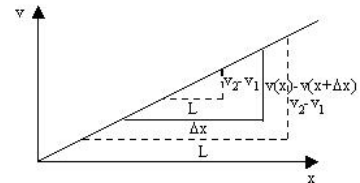


$$VG = \frac{(v_2 - v_1)}{L} = \frac{\Delta v}{L}$$

Strain rate

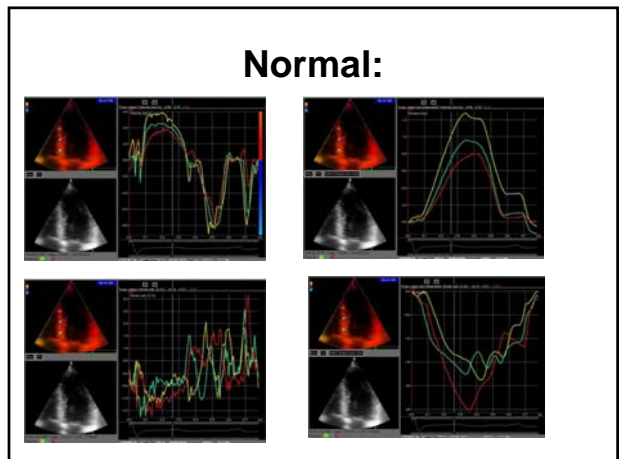
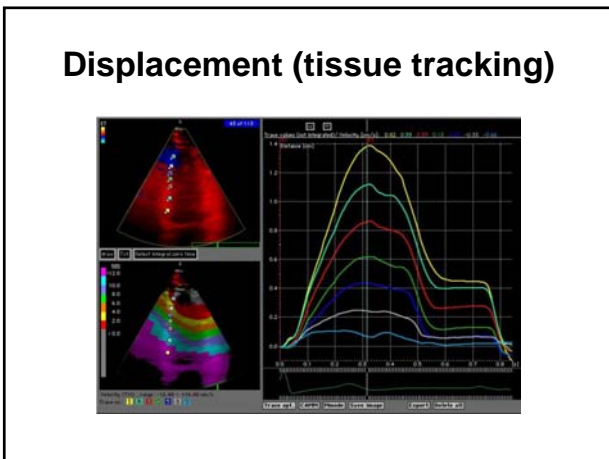
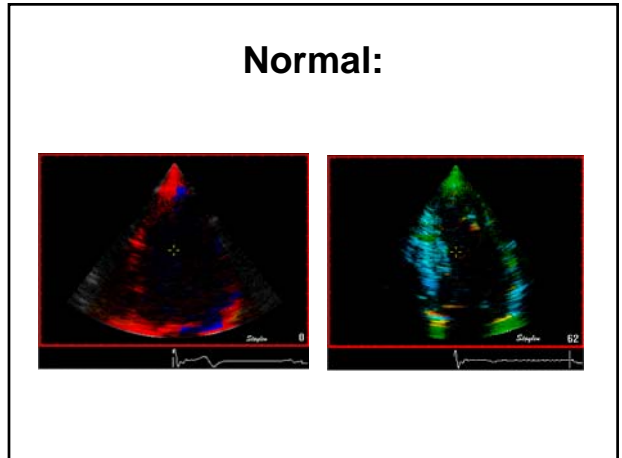
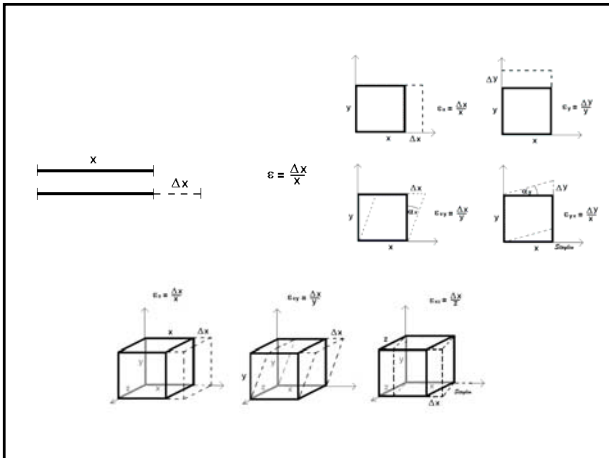
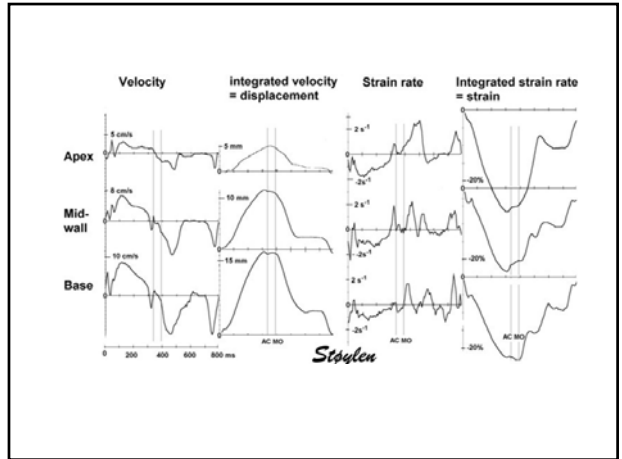
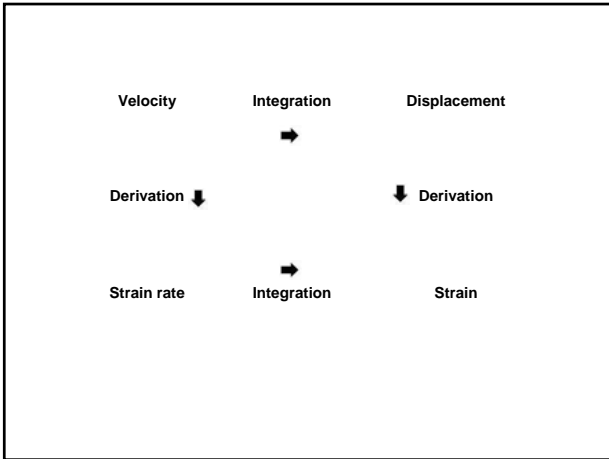


$$SR = \frac{v(x) - v(x + \Delta x)}{\Delta x} = \frac{\Delta v}{\Delta x}$$

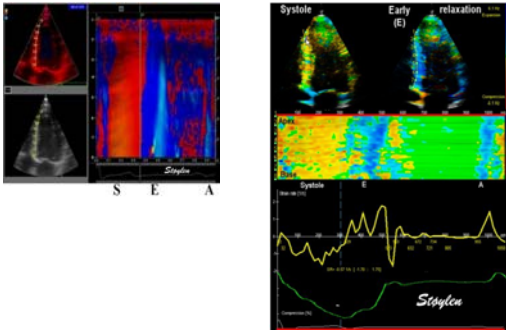


$$SR = \frac{v(x) - v(x + \Delta x)}{\Delta x} = \frac{\Delta v}{\Delta x} = \frac{(v_2 - v_1)}{r} = VG \approx \dot{\epsilon} \quad \dot{\epsilon} = \frac{\Delta \epsilon}{\Delta t}$$

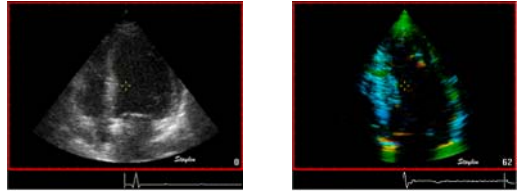
$$\epsilon = e^{\int SR dt} - 1$$



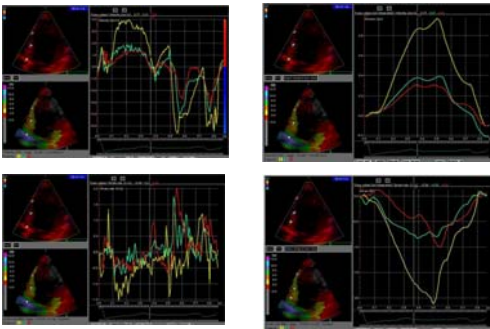
Normal, kurvet M-mode



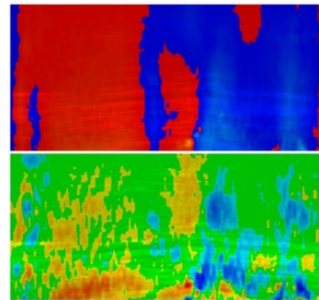
Fremreveggsinfarkt:



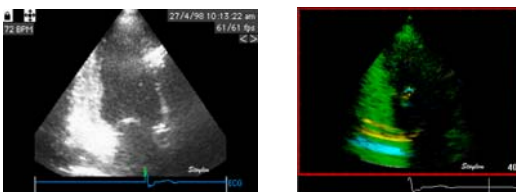
Fremreveggsinfarkt:



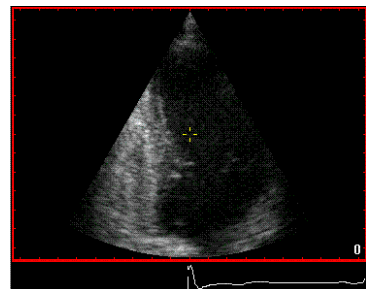
Fremreveggsinfarkt:



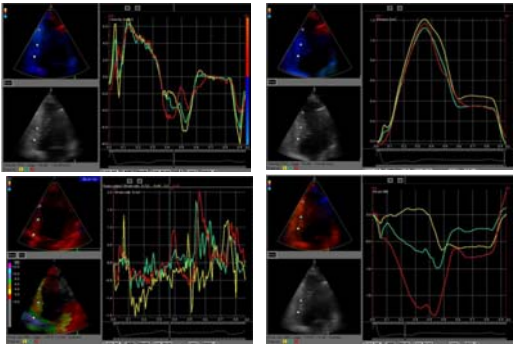
Nedreveggsinfarkt



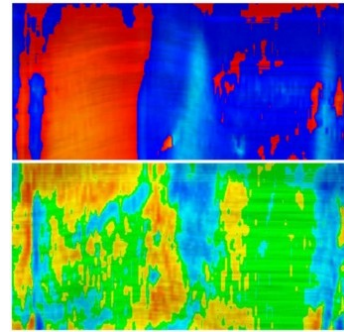
Nedreveggsinfarkt



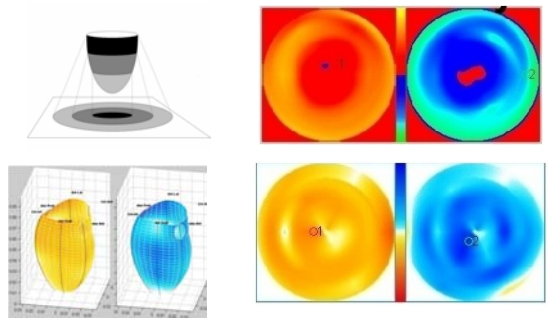
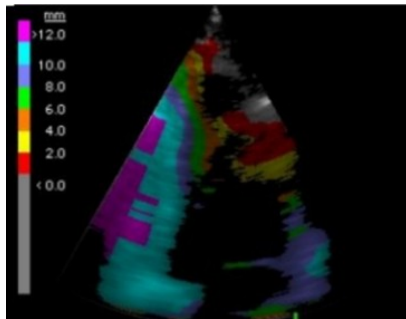
Nedreveggsinfarkt



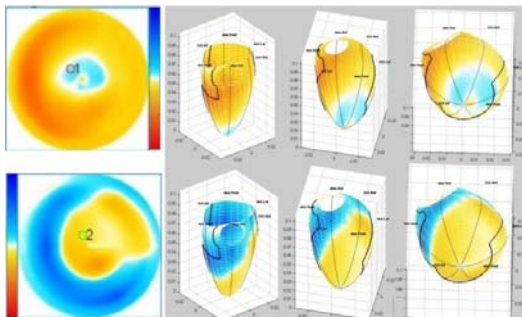
Nedreveggsinfarkt



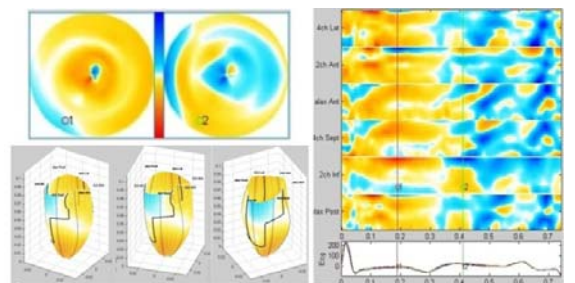
Nedreveggsinfarkt



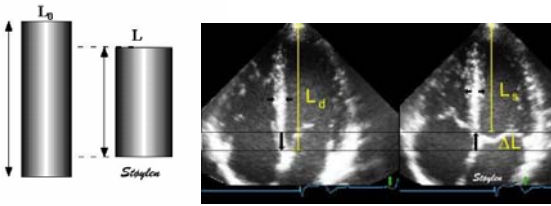
Fremreveggsinfarkt



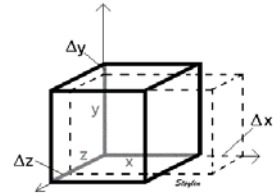
Nedreveggsinfarkt



Inkompressibilitet:

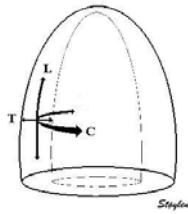
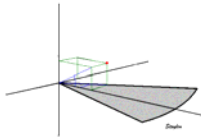
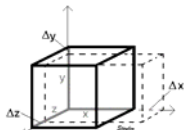


Inkompressibilitet:

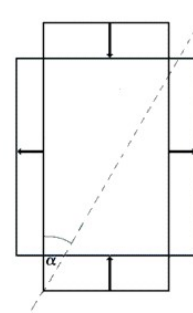


$$(\epsilon_x + 1) (\epsilon_y + 1) (\epsilon_z + 1) = 1$$

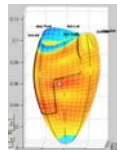
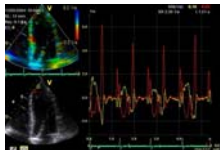
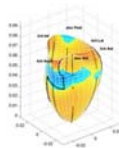
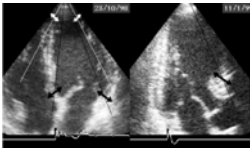
Koordinater:



Vinkelproblemet:



Vinkelproblemet:



Vinkelproblemet:

