

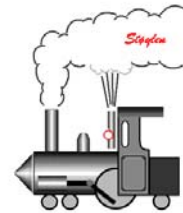
# Vevsdoppler:

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 Institutt for sirkulasjon og bildediagnostikk,

DMF,  
 NTNU

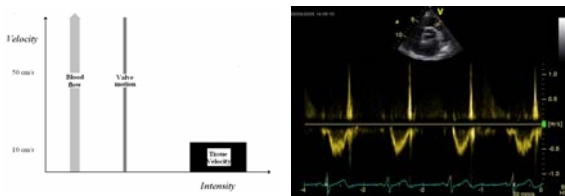
[www.ntnu.no/~stoylen/lectures](http://www.ntnu.no/~stoylen/lectures)  
[www.ntnu.no/~stoylen/strainrate](http://www.ntnu.no/~stoylen/strainrate)

# Samme prinsipp som Doppler flow:



$$f - f_0 \approx 2 f_0 \frac{v}{c} \cos(\alpha)$$

# Vevsdoppler

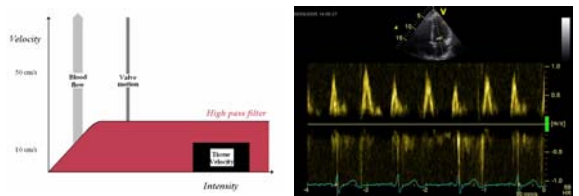


Prinsipielt som Doppler flow:

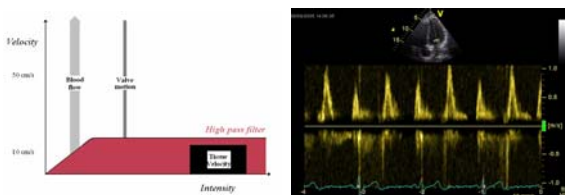
Blod: Høye hastigheter, lav intensitet (Høypassfilter)

Vev: Lave hastigheter, høy intensitet

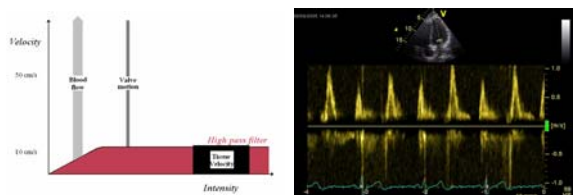
# Høypassfiltrering



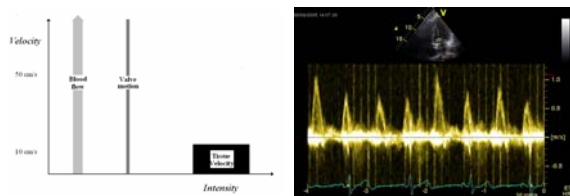
# Høypassfiltrering



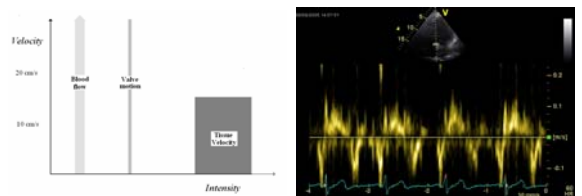
# Høypassfiltrering



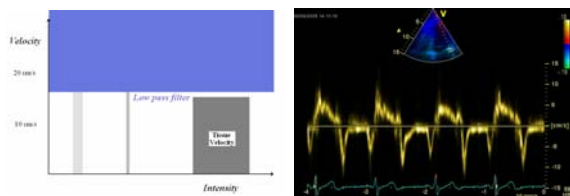
## Ingen filtrering



## Ingen filtrering, lav gain



## Lavpass filtrering



## Vevsdoppler:

- Beskrevet teoretisk 1976 (Angelsen)
- Pulset vevsdoppler 1989 (Isaaz)
- Farge vevsdoppler 1992 (McDicken)

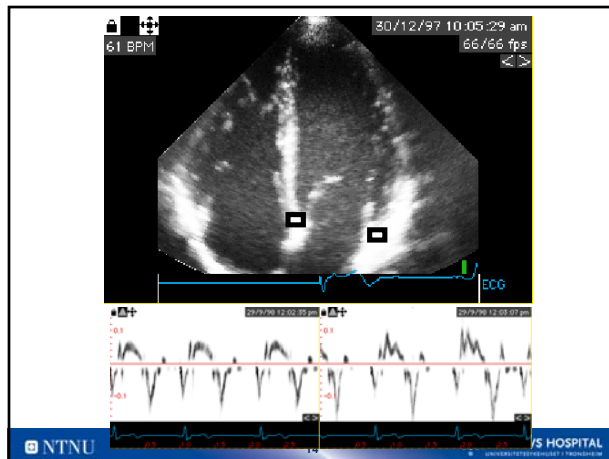
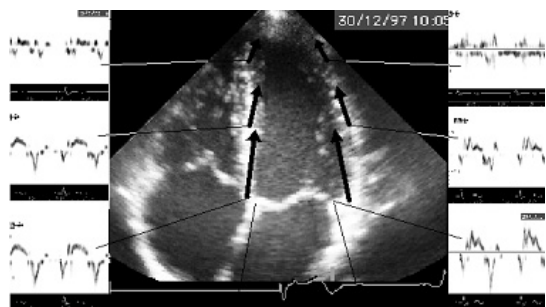
## Vevsdoppler:

- Pulset (Global funksjon)
  - Sekvensiell
  - Robust
  - Online (rask)
- Farge
  - Simultan (regional funksjon)
  - Sensitiv for støy
  - Postprosessering

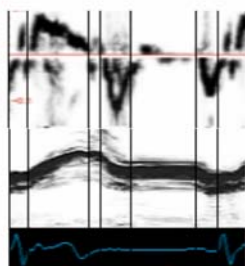
## Langaksebevegelsen:



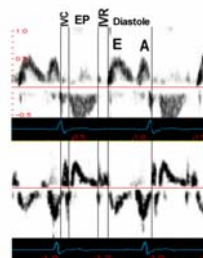
## Vevsdoppler:



## Pulset vevsdoppler



## Vevsdoppler og flow:



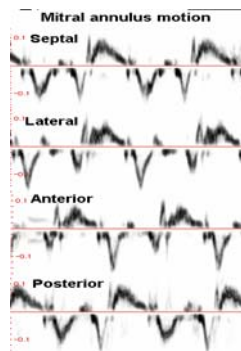
• Flow: Resultat av trykkforskjeller

• Kontraksjon: Årsak til trykkforskjeller

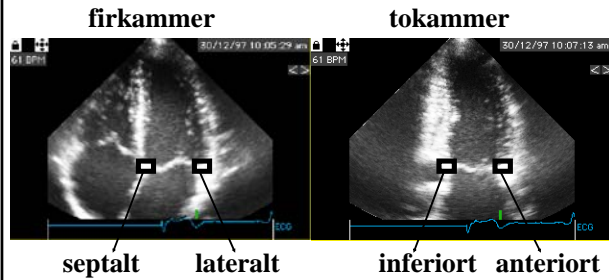
## Normalverdier systolisk hastighet:

- Gulati et al 1996:
  - Peak velocity korelerer med EF:  $R = 0.86$  (Støylen et al 2003:  $R = 0.66$ )
  - Peak velocity  $> 5,4$  cm/s tilsvarer EF  $> 50\%$
- Vinereanu et al 2001:
  - Peak velocity  $> 9$  differensierer mellom normal og patologisk hypertrofi (men alle med normal EF)
  - Normalverdi  $> 8$

## Posisjonsavhengighet :

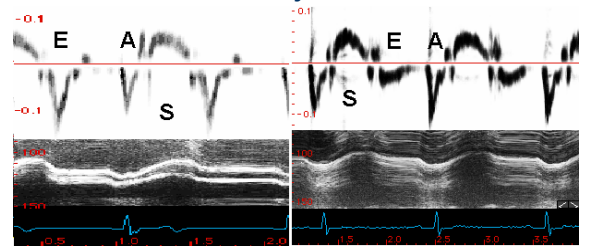


## Normalverdiene gjelder gjennomsnitt av 4 punkter:



Gjennomsnittet av 4 punkter reduserer også variabiliteten med 25%

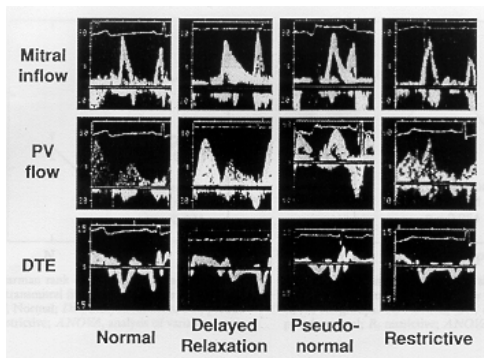
## Diastolisk funksjon VV:



Frisk person

Hypertensiv pasient med forsinket relaksasjon

## Diastolisk funksjon:



## Normalverdier for e-hast.i mitralannulus, forenklet

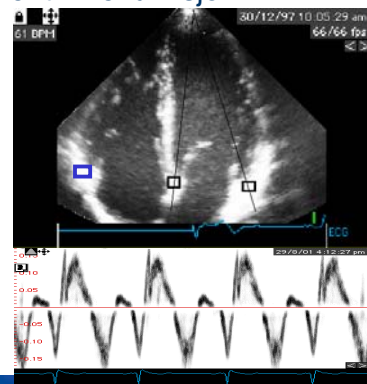
- Yngre voksne:
  - >10 cm/s
- Eldre voksne:
  - >8 cm/s

## E/A ratio i mitralflow vs Ea/Aa ratio til mitralannulus

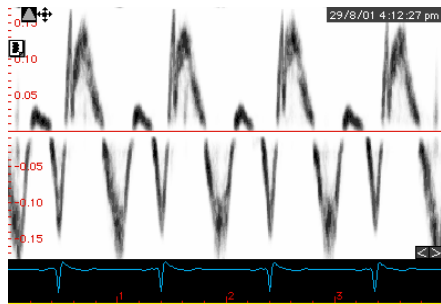
	Normale n=34	Forsinka relaksasjon n=40	Pseudonormale n=51
E/A	1,4±0,3	0,66±0,14	1,7±0,5
Ea/Aa	1,4±0,4	0,62±0,2	0,66±0,2
E/Ea	7,7±3	7,8±3,5	18±4

Nagueh 1997

## Høyre ventrikkelfunksjon:



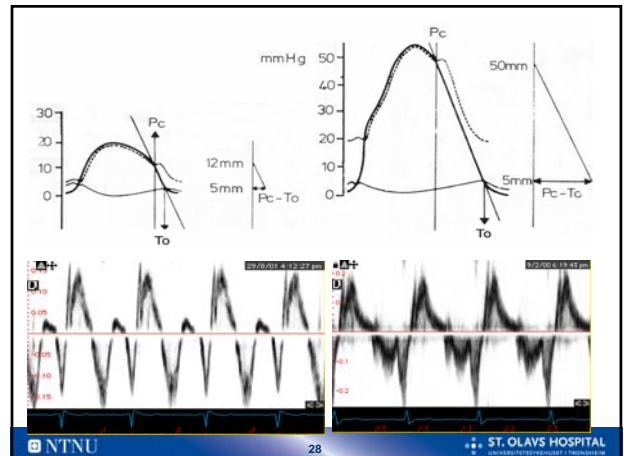
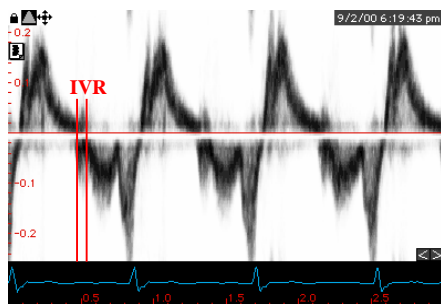
## Høyre ventrikkelfunksjon:



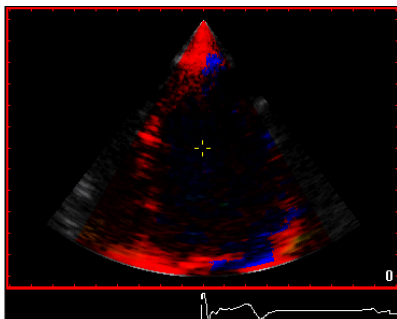
## Høyre ventrikkelfunksjon

- Peak systolisk hastighet av tricuspidalringen
- Et målepunkt.
- Normalt 15 cm/s = Normal høyre ventrikkelfunksjon patologisk < 10 cm/s (Alam 2000)
- Hø. Atrietrykk: E/Ea korrelerer dårligere med fyln. Trykk (Nageh 1999) (dessuten finnes bedre metoder som
  - Venestuvning
  - Vena cava)
- Systolisk pulmonalarterietrykk?
  - Påvisbar IVR (cfr Burstin 1967)

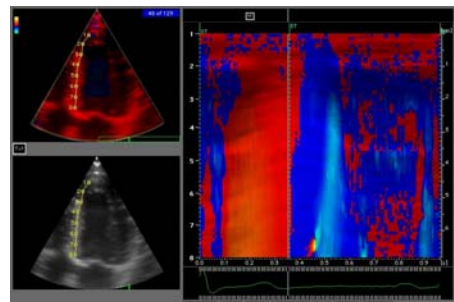
## RV IVR med vevsdoppler:



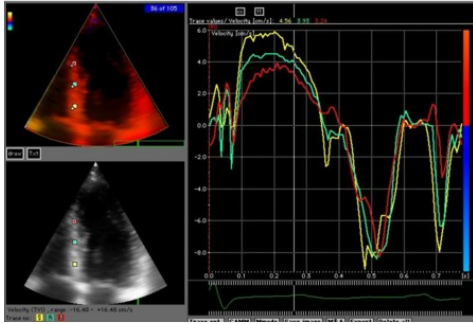
## Farge vevsdoppler:



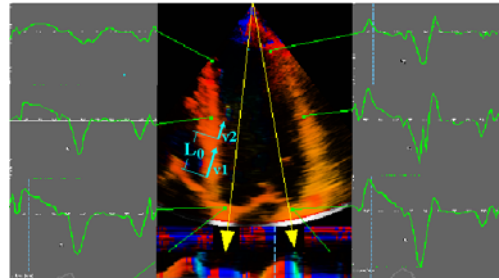
## Curved M-mode (CMM):



## Kvantitative kurver



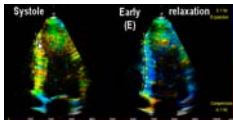
## Strain rate:



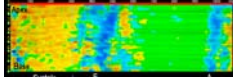
$$SR = v_1 - v_2 / L_0$$

## Strain rate Imaging.

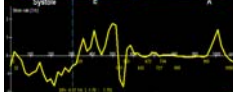
2D:



M-mode:



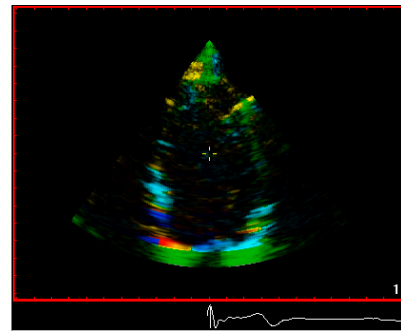
Strain rate:



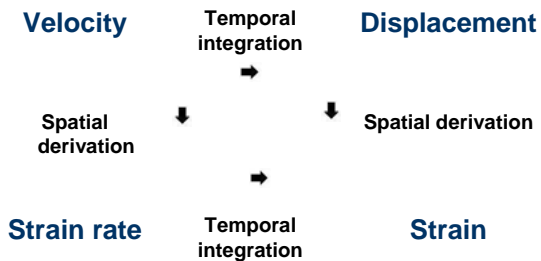
Strain:



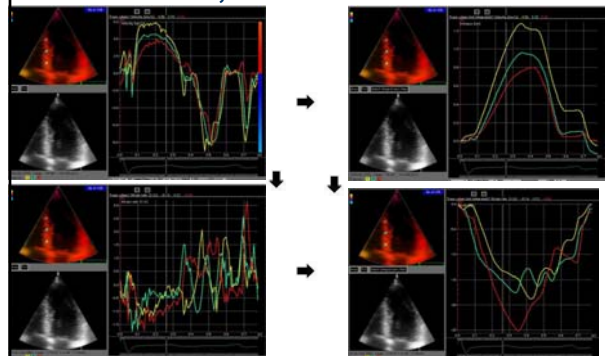
## Strain rate imaging:



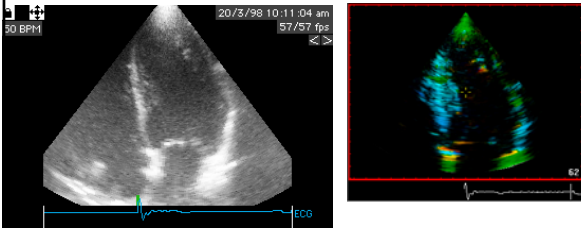
## One dataset, four modalities:



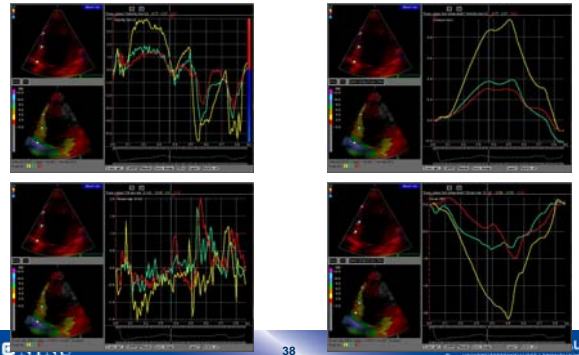
## One dataset, four modalities:



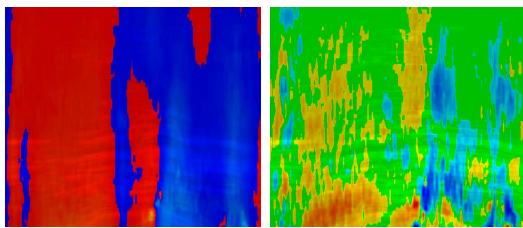
# FVI



# FVI



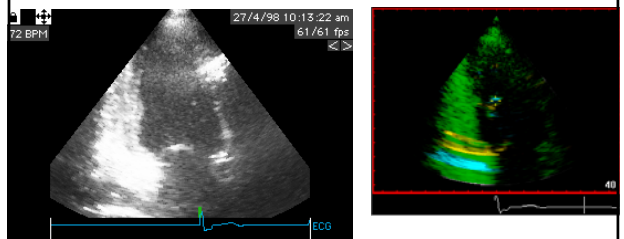
# FVI



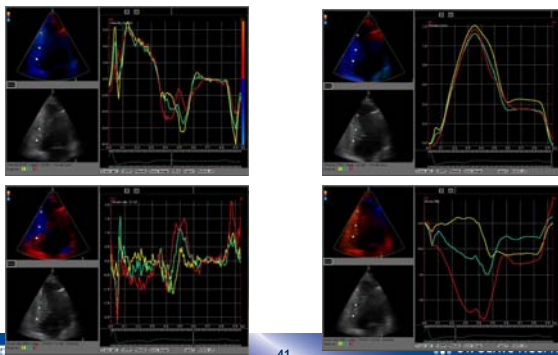
• DTI

SRI

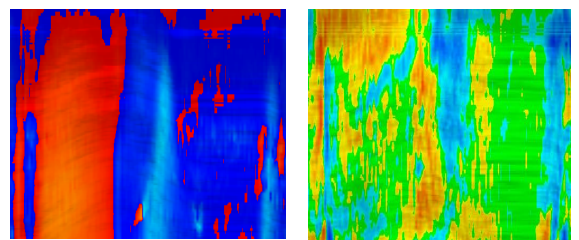
# NVI:



# NVI



# NVI



• DTI

SRI

## Regional funksjon:

- Hvor er det dysfunksjon
- Hvor utbredt er dysfunksjonen
- Hvor uttalt er dysfunksjonen

## Hvordan bruke vevsdoppler?

- For tilleggsdata og usikkerhet:
  - TVI. Utelukkelse
  - Verifisering
- For lokalisasjon av patologi
  - Strain rate / Strain
  - MED KRITISK BLIKK

[www.ntnu.no/~stoylen/strainrate](http://www.ntnu.no/~stoylen/strainrate)