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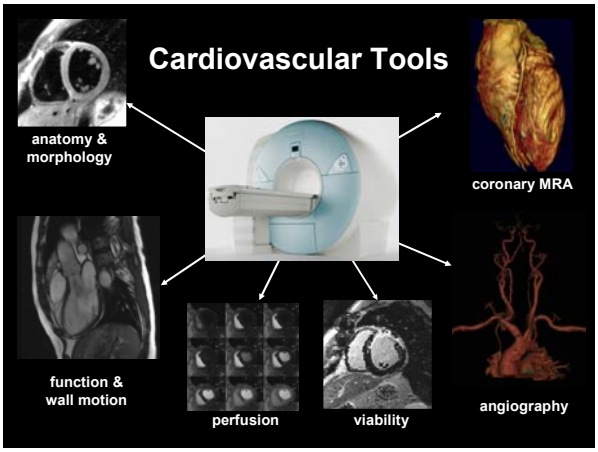
State-of-the Art Technology in Cardiac MR

Gerhard Laub, Ph.D.
Siemens Medical Solutions

 1



Total Imaging Matrix: Tim

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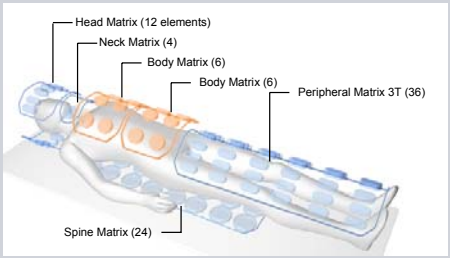

- Up to 105 coil elements
- Connected into 32 channels

 3

Parallel in all Directions

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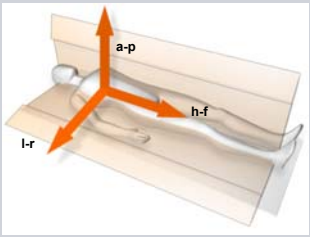
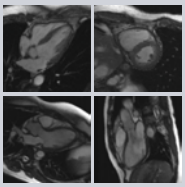
- High-speed / high-resolution parallel imaging.
- In all directions, whole body.
- No need for specific PAT coils anymore.





Parallel imaging independent of slice orientation

 4

Real-time Cine Imaging

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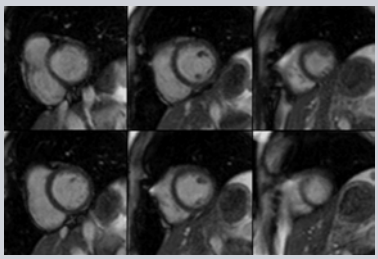

- TSENSE x 3
- 65 msec true temporal resolution
- 80x192 matrix, 255mm x 340mm x 8mm
- TE 1.1 msec, 80º flip angle TrueFISP

 5

High spatial resolution in real time

32 channel cardiac coil, PAT 4 , **T-SENSE**

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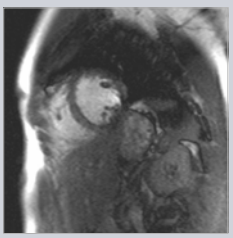

- Res: 1.1 x 0.8 mm²
- TA: 92 ms / image
- PAT 4

Courtesy of Rapid Biomedical, Wuerzburg Germany

 6

GRE-EPI with T-SENSE X 2

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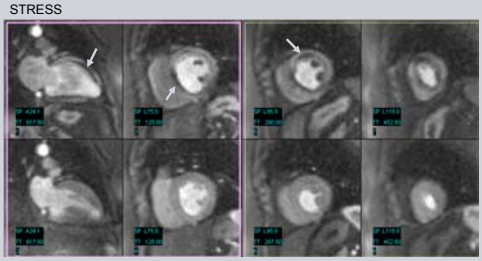
Case example: anterior and inferior first-pass defects

STRESS



REST

Courtesy of Northwestern Memorial Hospital, Chicago

 7

3D Perfusion with iPAT2 and T-SENSE

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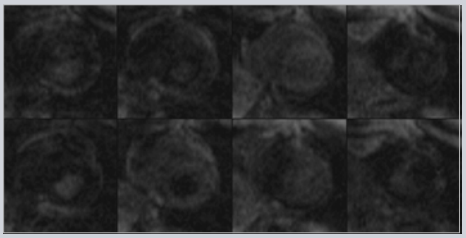
Full cardiac coverage with PAT 8 (4 x 2)



- GRE-EPI Inversion Recovery / Fat Saturation
- Matrix: 128x64; FA: 30°; BW/pixel: 1860 Hz; EPI 4; 1D T-SENSE R=2;
- 8 Partitions, 50% slice resolution; TI 200 ms; TR / TE 5.5/1.2ms

 8

Two in one : Cine – Late Enhancement

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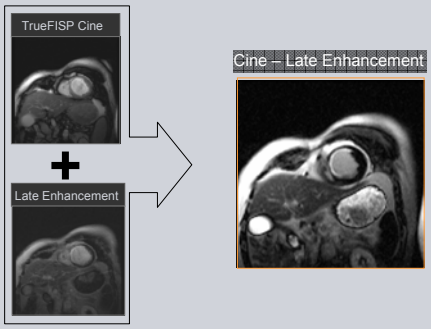
Combined wall motion and late enhancement in one exam



J. Kim, R. Setser, R. White, A. Stillman, Cleveland Clinic

 9

Cine Late Enhancement

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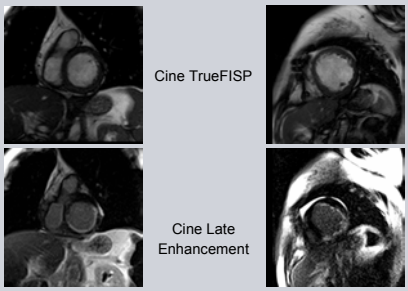

Images courtesy Dr. Regenfus, Uni Erlangen

 10

3D Coronary Imaging

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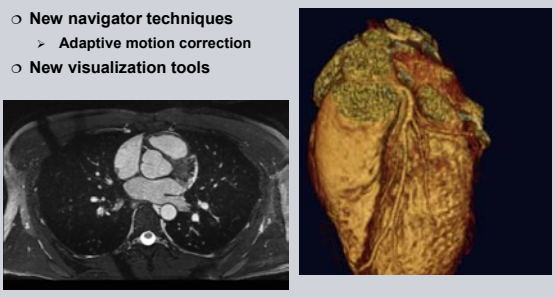
without contrast agent

- **New navigator techniques**
  - **Adaptive motion correction**
- **New visualization tools**



 11

Free Breathing Coronary MRA

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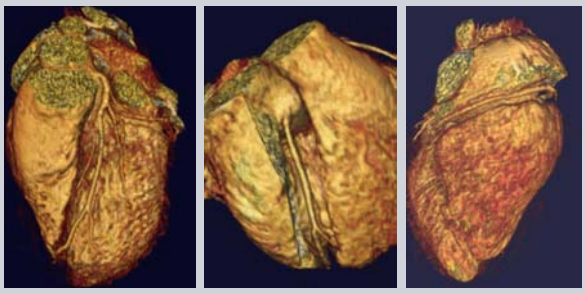

 12

Free Breathing Coronary MRA

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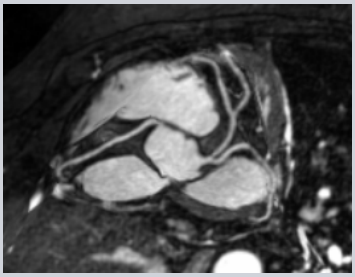

Soap Bubble Reformat

 13

Non-contrast MRA: Dilated aorta

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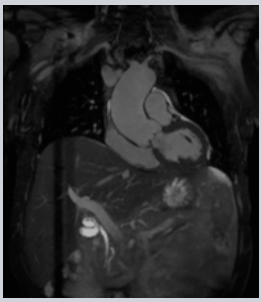
TR / TE / flip = 2.3 ms / 1.0 ms / 90°
FOV = 500 mm × 500 mm
Matrix = 320 × 320
slc thk = 4 mm interpolated to 2 mm
TA = 6min, 15sec
Free breathing



Thickened aortic valve

Courtesy of Dr. Finn, UCLA, Los Angeles

 14

Transposition of the great vessels

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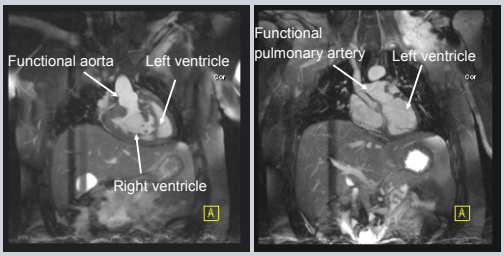

TR / TE / flip angle = 2.3 ms / 1.0 ms / 90°
FOV = 420 mm × 420 mm, Matrix = 256 × 256
Slice thickness = 4 mm interpolated to 2 mm
TA = 9min, 59s.

Courtesy of Dr. Finn, UCLA, Los Angeles

 15

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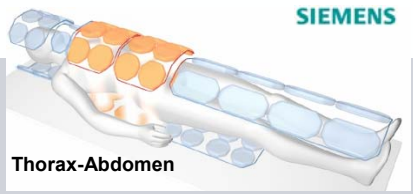
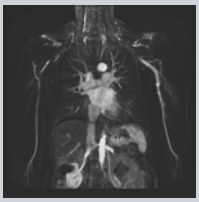
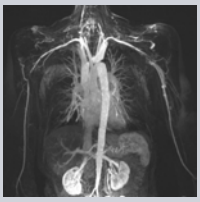


Thorax-Abdomen

Tim:
Large FOV
&
High Resolution



Thin MIP



MIP

 16

Dynamic MRA with T-SENSE [2]

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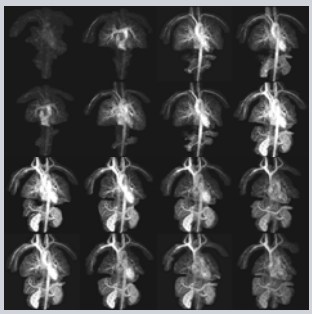

Acceleration: **8**
Matrix 256x256x40
FOV 400x400x120 mm³
TR/TE 3.5/1.1 ms
TSENSE 4x2

Acq time/meas **2.7 s**

Rapid 32 channel coil
Tim Avanto [76x32]

Courtesy of P Kellman, NHLBI, NIH, Bethesda, MD, USA

 17

Dynamic MRA Using TWIST:

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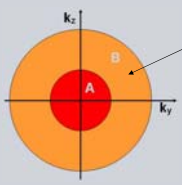
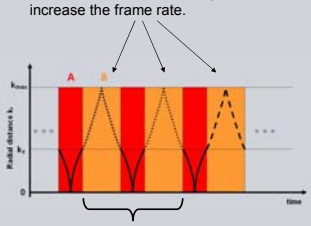
As is well-known, k-space can be divided into two regions, A and B.
"A" defines the overall image contrast, and "B" adds object details.



In the TWIST sequence, region B is scanned at a lower sampling rate to increase the frame rate.



n-th frame

 18

Dynamic MRA Using TWIST:

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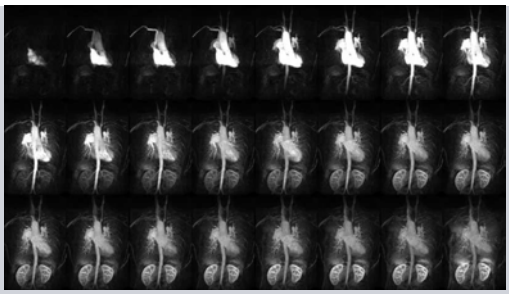

Congenital Vascular Disease

Time-resolved (iPAT x 2)
1.3 x 1.1 x 4.0mm³
1.8 sec / frame

Avanto, UCLA

 19

Dynamic Peripheral MRA at 3.0 T

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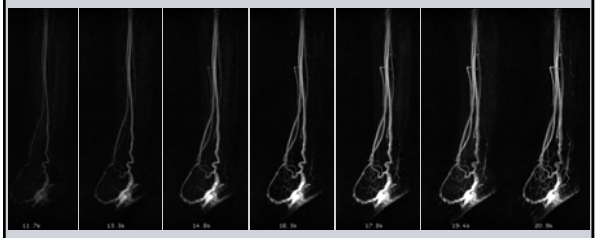

AVM, time-resolved MRA using TWIST

 20

Cardiac MR at 3T

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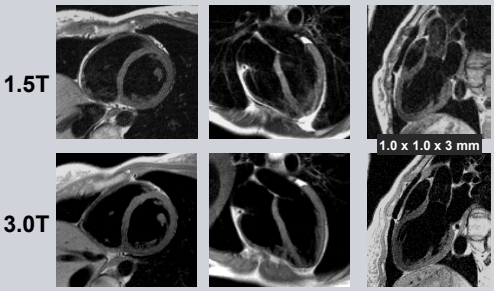

Courtesy of Dr. Miller, University of Tuebingen

 21

Comparison of 3T and 1.5T

- resting first-pass perfusion -

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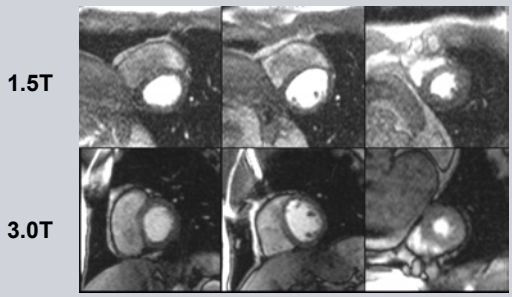

➔ Higher SNR at 3T

Courtesy of Drs. J. Salanitri and J. Carr, Northwestern University

 22

Comparison of 3T and 1.5T

- tagging sequence -

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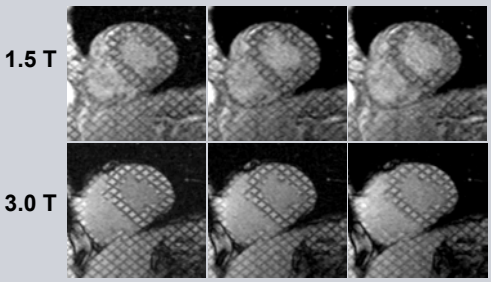

➔ Better CNR at 3T

 23

Cardiac Function @ 3T

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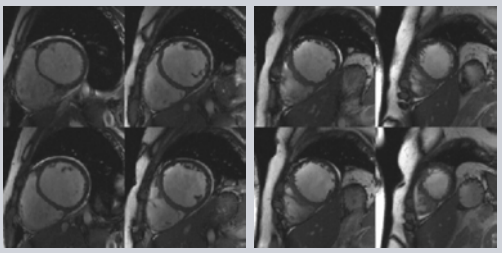

Cine TrueFISP

courtesy of Dr. Miller, University of Tuebingen

 24

Cardiac MRI @ 3T

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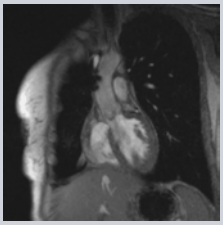
Aortic valve leaflet defect



Aortic regurgitation

Cine FLASH to avoid off-resonance artifacts

Courtesy of Dr. Finn, UCLA

 25

Viability & Function @ 3T

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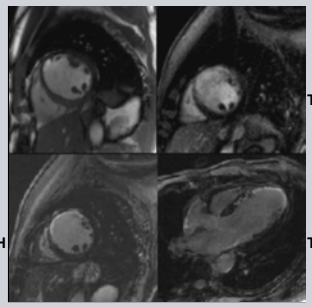
Cine TrueFISP

IR single shot TurboFLASH



IR segmented TurboFLASH (4 hb)

IR segmented TurboFLASH (4 hb)

courtesy of Dr. DiBello, University of Utah

 26

Cine, Perfusion, and Viability @ 3T

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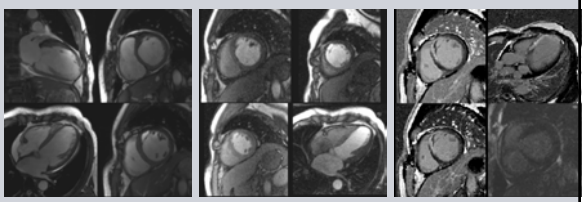

Cine TrueFISP

SR TurboFLASH + TSENSE

Phase sensitive IR TurboFLASH

function

perfusion

viability

Courtesy of Dr. Finn, UCLA

 27

Pulmonary MRA

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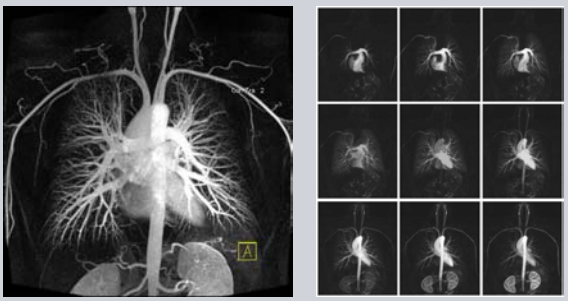

high res, 20sec

Dynamic MRA (TWIST) 1sec resolution

Courtesy of Dr. Finn, UCLA

 28

Aortic Dissection

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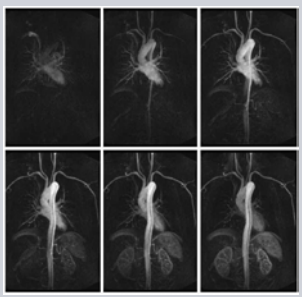
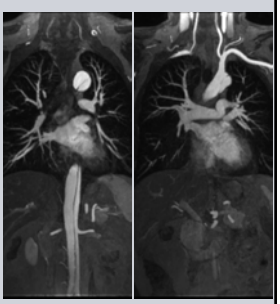


Dynamic MRA (TWIST)

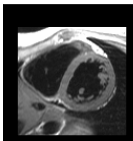


High-res MRA (Thin MIP)

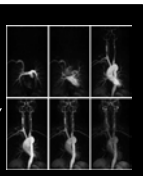
Courtesy of Dr. Finn, UCLA

 29

State-of-the Art Cardiovascular Tools 1.5T and 3T

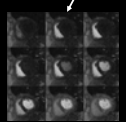


anatomy & morphology

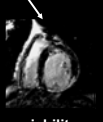


dynamic MRA

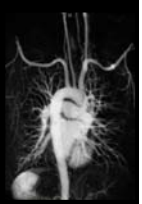
function & wall motion



perfusion



viability



angiography