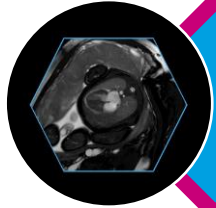




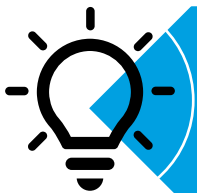
Section 3 - How to adapt sequences and optimize images



3.1 BFFE Cine Setup



3.2 Flow quantification



3.3 Tips & tricks and Challenges



3.4 Common pitfalls and artifacts



BFFE Cine Setup

➤ Acronyms (Philips: BFFE, Siemens: TrueFISP, GE: FIESTA)

1. Cine Breath Hold (BH) Images: Gold standard - Transversal Full Stack Cine BH

Maternal breathing artifacts can affect fetal scans, so the mother is asked to breathe shallowly to reduce movement and prevent heartbeat interruptions.

Aim: adapt the necessary parameters for 3 & 1.5 T scanners as suggested in Table below.

	Default 3T MR	Default 1,5T MR	Range	Comments
Field of View FoV [mm ²]	260 x 260	260 x 260	250 to 320	
Fold-over suppression [mm] / Phase Oversampling / No Phase Wrap	30 (Left) / 30 (Right)	30 (Left) / 30 (Right)	20% to 70%	Adjust for individual patient to avoid backfolding artefacts
Slice thickness [mm]	4	5	4 to 6	
# Slices	12	12	1 to 16	Adjust for individual patient
In-plane pixel ACQ [mm ²]	1.7 x 1.40	1.8 x 1.50	1.4 to 1.9	
In-plane pixel Recon [mm ²]	0.99 x 0.99	1.05 x 1.05		
Flip angle [deg]	60	70	45 to 70	RF-flip angle (α) is made large to accentuate T2/T1 contrast and produce bright blood images





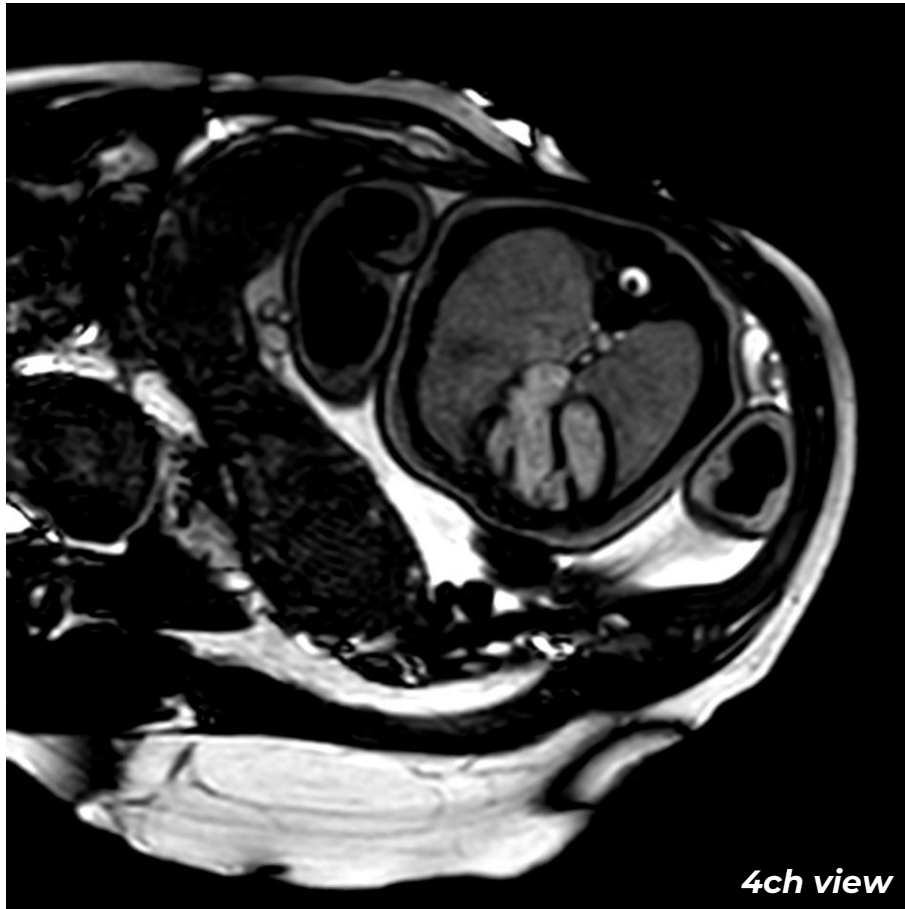
	Default 3 T MR	Default 1,5T MR	Range	Comments
Repetition time TR / Echo time TE [ms]	3.5 / 1.74	3.4 / 1.71	-	Keep TR & TE as short as possible, avoid TR > 4 ms
Temporal resolution [ms]	25	25	20 to 33 ms	Philips: Displayed as "TFE dur. acq" on ExamCard Info page; For modification adjust Recon and ACQ heart phases on Motion tag. Higher resolution (shorter TFE duration) increases scan time. Siemens: TR depends on the number of "Segments". Changing segments alters temporal resolution, TR, and scan time. GE: "Segments" control temporal resolution, TR, and scan time. Temporal resolution = TR × views per segment.
ACQ heart phases	15.5	15.5		Auto adjusted according to the patient heart rate
ACQ heart phases (%)	60	60	50 to 75	Adjust for temporal resolution
Recon heart phases	25	25	25 to 50	Modification may lead to change of the scan time
Number of acquisition NSA / Average / NEX	1	1	1	
Acceleration factor (SENSE / Grappa or CS-SENSE)	SENSE 2	SENSE 2	SENSE 1 to 2	SENSE preferred
Breath hold (BH) time [s]	6	6	5 to 14	Depend on temporal and spatial resolutions
Scan time [s]	1:17	1:12		Depend on # slices, temporal and spatial resolutions
RF shim	Adaptive	Adaptative		Adjust the shim box for individual patients
B0 shim	Volume	Volume		Adjust the shim box for individual patients



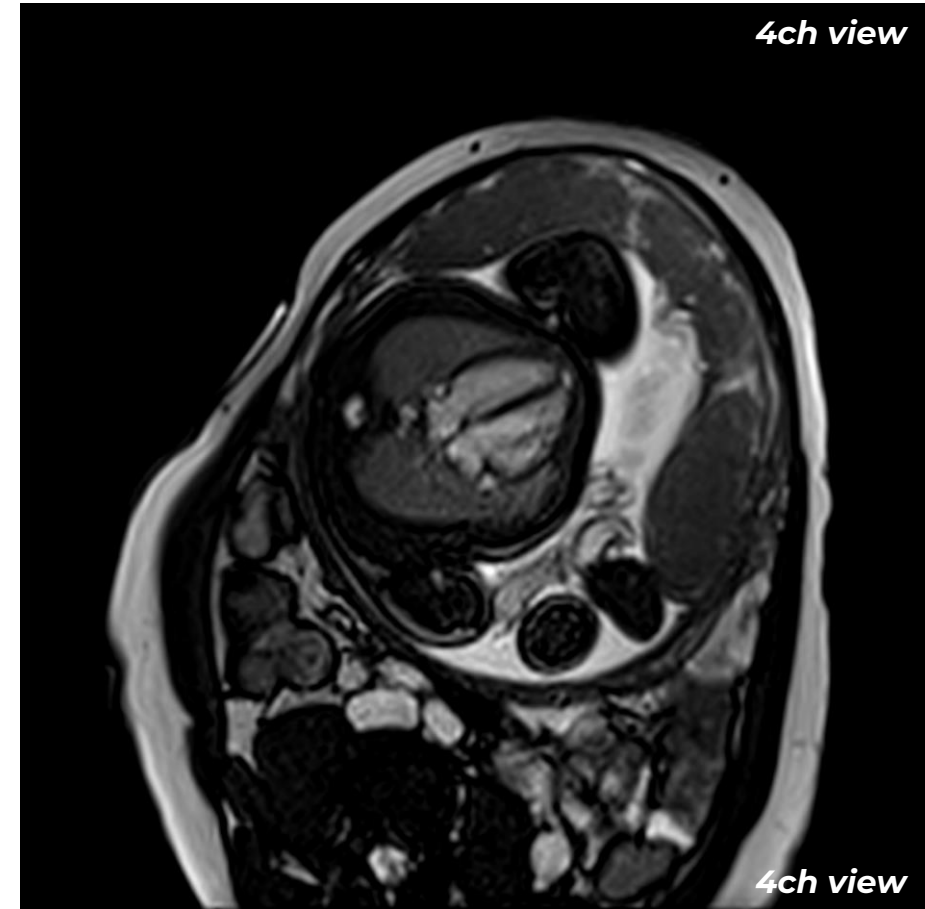


Note: Below are the respective images for MRI 3T and 1.5T acquired using the parameters suggested in the table.

➤ **3T**



➤ **1.5T**





BFFE Cine Setup

1.2 Cine Breath Hold (BH) Images: Compressed Sensing (CS) Sense - Transversal Full Stack Cine BH

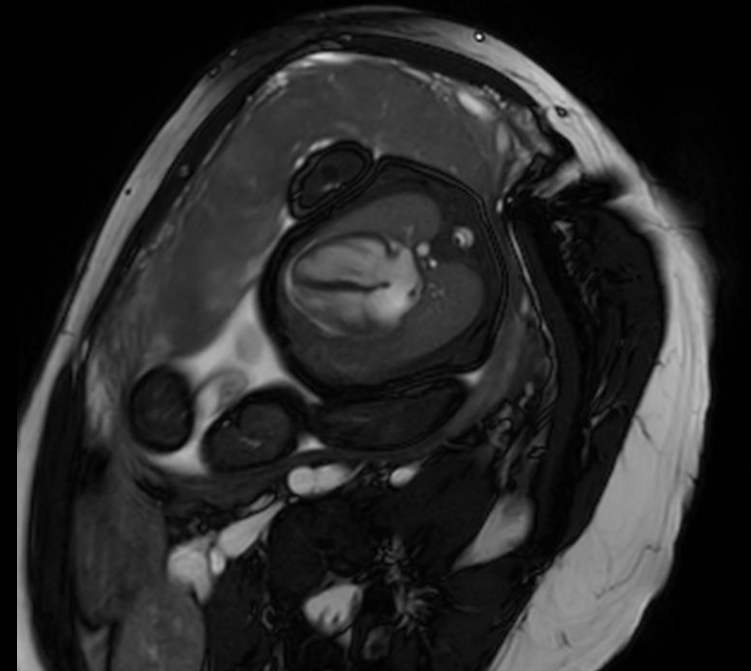
Aim: Adjust the existing Cine BH sequence parameters as indicated below to significantly reduce scan time while maintaining high-quality images.

Example CS Cine BH on 1,5T MRI: 34 gw (HR : 140bpm)

➤ **Step 1.**
CS-SENSE : acceleration factor of 3

*You can use value between 2 and 3 by
reducing the acquisition time &
increasing the image quality*

Applications consideration: This technique is particularly useful in patients who have difficulty holding their breath, those with irregular heart rhythms, or situations requiring rapid imaging





BFFE Cine Setup

If the mother has difficulty holding her breath, the CINE technique in Free Breathing (FB) can be used instead.

1.1 Cine FreeBreathing(FB) images: in case BH not possible - Transversal Full Stack Cine FB 2NSA

Aim: Adjust the existing Cine BH sequence parameters as indicated below to achieve a stable Free Breathing sequence.

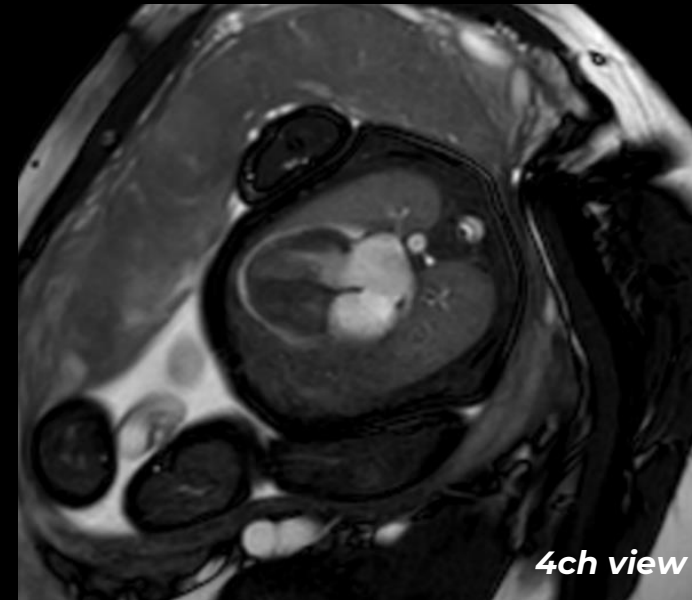
Example Cine FB on 1,5T MRI: 34 gw (HR : 140bpm)

➤ **Step 1.**
Resp. compensation: no

➤ **Step 2.**
CS-SENSE is available? you can use it instead of SENSE with values between 2 and 3 by reducing the acquisition time & reducing the noise

➤ **Step 3.**
NSA/Average/NEX: 2-4

Increase NSA (minimum=2)
(the higher the better if the time allow)





BFFE Cine Setup

1.3 Cine BH High Resolution (HR) on pure planes (sa,4ch,2ch...).

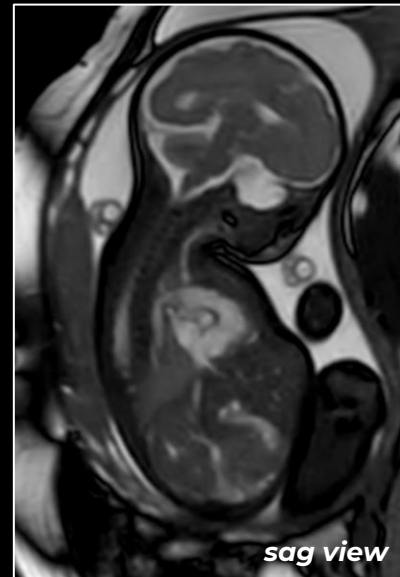
Aim: Adapt the existing Cine BH sequence parameters as indicated below increasing the spatial resolution.

Example Cine BH HR on 1,5T MRI: 27 gw (HR : 150bpm)

➤ **Step 1.**
Slice thickness(mm): 4(3T) & 5(1,5T)

➤ **Step 2.**
Slices: 1-3

➤ **Step 3.**
Spatial resolution/In-plane pixel ACQ [mm2]:
1.6x1.45 (3T) & 1.65 x 1.55 (1,5T)





2. Video sequence overview and settings on Philips scanner

➤ Sequences selection

The screenshot displays the Philips scanner software interface. The top menu bar includes 'Patients', 'Examination', 'Review', 'Analysis', 'System', and 'Help'. The top right corner shows the date and time '26-Nov-2024, 08:22' and the 'PHILIPS' logo. The main window is divided into several sections:

- Left Panel:** Contains patient information fields for 'Registration ID:', 'Date of Birth:', and 'Gender:'. Below these are icons for a list and a calendar. A status bar indicates 'No ExamCard selected' with a timer at '00:00:00'. A note says 'Drag ExamCard or scan item here to add it to the scanlist'. At the bottom, there are 'Start Scan' (green) and 'Stop Scan' (red) buttons.
- Top Center:** A large black area for video sequence overview, currently empty.
- Bottom Panel:** An 'ExamCards' window is open, showing a list of sequences under the 'Hospital' tab. The list includes 'Fetal CMR', 'Fetal CMR 3T', and 'Fetal CMR 1.5T'. A mouse cursor is hovering over 'Fetal CMR 1.5T'. To the right of the list is an 'Info' panel with tabs for 'Info', 'Assistance', and 'AutoView'. A status bar at the bottom of the ExamCards window shows '08:22 Added the selection to Scanlist'.





➤ Sequences settings

Patients Examination Review Analysis System Help 26-Nov-2024, 09:05 PHILIPS

Registration ID:
Date of Birth:
Gender:

Plan
Review

Fetal CMR 3T 00:06:19

- Cine BH Axial...
- Cine FB 2NSA... axial
- cs Cine BH Axi... axial
- Cine BH HR cine

+ Add new scan item...

Cine BH HR 00:22 3x00:07 Voxel 1.59 x 1.46 x 4.00 Sag Rel. SNR 1.01 TE 1.82 TR 3.6 SAR < 1.1 W/kg PNS 58%

Accept Cancel

Summary Physiology Geometry Contrast Motion Dyn/Ang Postproc Offc/Ang Coils Conflicts <<

	FH (freq.)	AP (phase)	RL
FOV	254	254 mm	12 mm
Voxel	1.6 (1.55)	1.45 (1.4) mm	4 mm
Matrix	160	173	3 slices
NSA	1	Gap <input type="checkbox"/> Default	0 mm

Info Assistance AutoView

Fetal cardiac gated by smart-sync

- Breathhold (switch off for free breathing, NSA >1 may be needed)