UCSD Center for fMRI

Release 0.0.1

Oct 07, 2019

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CHAPTER 1

Upcoming Events

1.1 Simmons fMRI Analysis Course

When?

• Friday's from 2:00 - 3:00

Where?

CFMRI Conference Room

1.2 CFMRI Guest Speaker Seminars

TBD

CHAPTER 2

Previous Seminar Materials

2.1 Previous Seminars

2.1.1 An Introduction to BIDS: Data Organization for Transparency and Reproducibility in Neuroimaging Research

Speaker: Amanda Bischoff-Grethe Date: November 14th, 2018 Intro to BIDS_Bischoff-Grethe

CHAPTER 3

Imaging Protocol Documentation

3.1 CFMRI Imaging Protocol Documentation

3.1.1 CFMRI Multiband Protocol #1

Protocol Location and Receiver Coil Info

The ABCD protocol requires the use of the Nova Medical 32 channel head coil

The ABCD protocol can be found on both the 3T West and 3T East scanners under: * Adult >Template-> C_CFMRI_ABCD_Scan_Session1_v22

Pre-Scan Preparation

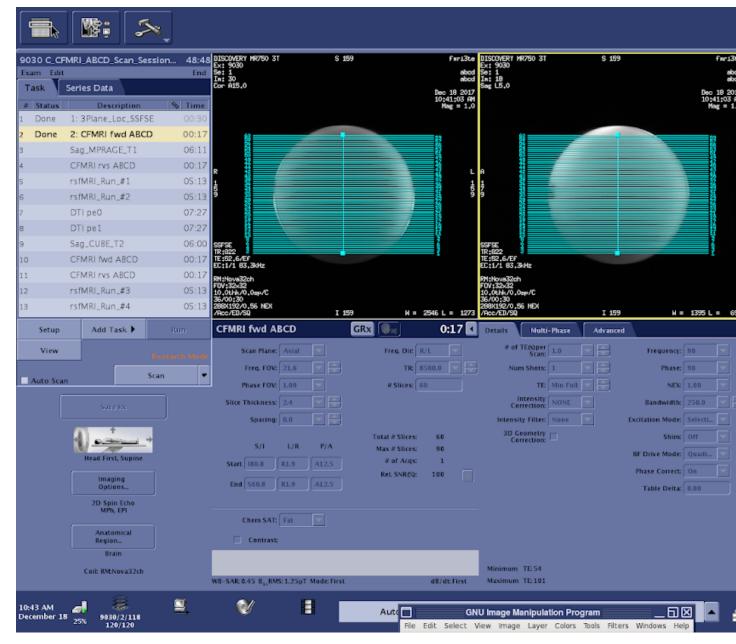
- Place the 32channel coil on the scanner table and plug it in
- Make sure the coil is recognized by the scanner by checking on the iROC monitor above the patient bed
- Setup peripheral equipment such as the projector, screen, stimulus laptop, etc.
- Setup the subject (blanket, emergency communication device, mirror, etc.) on the scanner patient bed
- · Setup physiological monitoring if needed
- Register the subject and "Start Exam"

Data Acquisition: EPI & Topup Distortion Correction

CFMRI fwd ABCD (~17 sec)

• Magnetic susceptibility and geometric distortion artifacts can be addressed by acquiring two short sequences with opposite phase encoding directions (1. Forward: Anterior->Posterior, 2. Reverse: Posterior->Anterior), followed by preprocessing using FSL topup https://fsl.fmrib.ox.ac.uk/fsl/fslwiki/topup

- The ABCD topup scans should have 60 slices
- The topup scans do not utilize multiband acceleration
- The number of slices you see in the Rx reflects the total acquisition coverage
- Center the slices over the desired location in the brain



• Save Rx->Scan

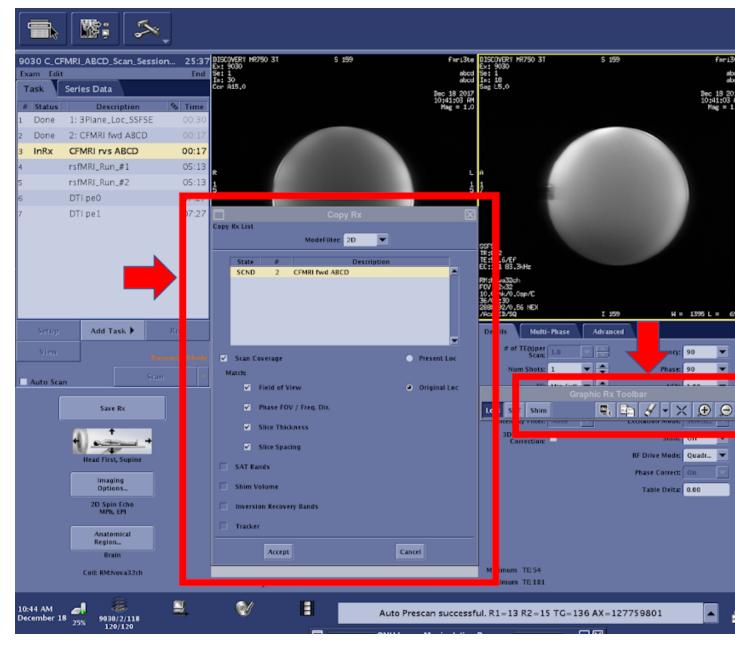
- There may be a long (20 sec) pause before the topup scan begins

CFMRI rvs ABCD (~17 sec)

• To run the second (rvs) topup scan you will need to copy the Rx from the previous topup scan (fwd)

• Use the Graphic Rx Toolbar

- Select the previous topup (fwd) scan Rx



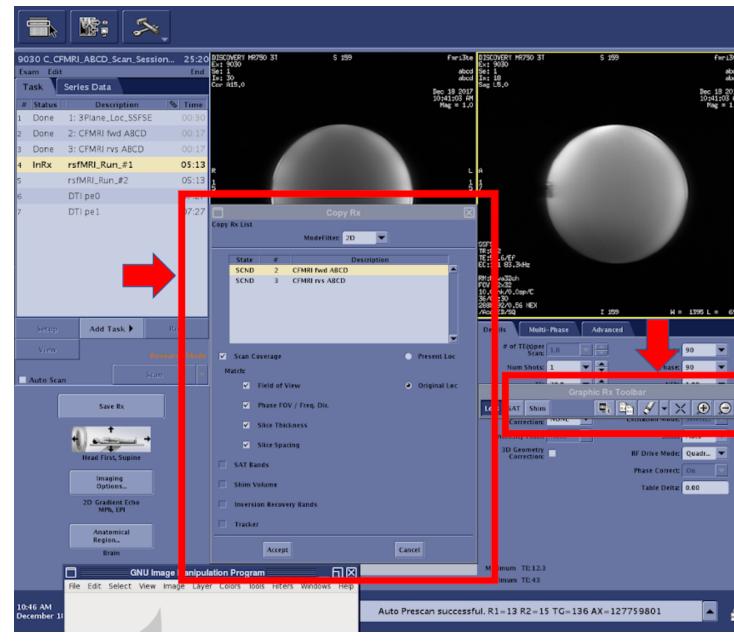
• Save Rx->Scan

rsfMRI_Run_#(1-4) (~5.5 min each)

- The multiband ABCD fMRI sequence acquires 60 total slices using a multiband factor of 6.
- Using the current GE MR750 software available on CFMRI scanners, only 10 of the 60 slices are visible during the final Rx setup phase

	X:				
Exam Edit Task Se # Status	RI_ABCD_Scan_Session ries Data Description & : 3Plane_Loc_SSFSE	2 5:20 DISCOVERY MR750 3T S : End Discovery MR750 3T S : End Discovery MR750 3T S : Discovery MR750 3T S : Cor R15.0	159 Fari3te abod Beo 10 2017 10:41:03 AM Mag = 1.0	DISCOVERY MR/50 3T S 159 Ex: 9030 Set 1 Int 18 Sag L5,0	Far13 abb Dec 18 20 10;41:03 / Mag = 1
2 Done 2 3 Done 3 4 InRx rs 5 rs 6 D	: CFMRI fwd ABCD : CFMRI rvs ABCD :f MRI_Run_#1 :fMRI_Run_#2 TI pe0	00:17 00:17 05:13 05:13 07:27	L 400	A 1109	
7 D	TI pel	07:27 SSFSE TR:822 TE:82,6/EF ED:11/1 83,384z FM:Howa32ch FOV:32:42 10.0tH:/v0.0sp/C 36/00:30 2860132/0.56 NEX 2860132/0.56 NEX	159 H = 2546 L = 1273	SSFSE 11:822 11:822 E:11/1 83,34Hz Mithous32ch F0V:32A2 10.04Hz/0.0ep/C 35/00:30 288K152/0.756 HEX /Rec/EU/SQ I 159	H = 1395 L = 66
Setup	Add Task 🕨 🔤	iii rsfMRI_Run_#1	GRx 🕵 5:13 🕻	Details Multi-Phase Advanced	
View Auto Scan	Save Rx	It Mode Freq. FOV: 21.6 Phase FOV: 1.00 Slice Thickness: 2.4 Spacing: 0.0	Freq. Dir. R/L 💌 TR: 800.0 💌 💭 # Slices: 10	# of TEOpter 1.0	Frequency: 90 V Phase: 90 V olbar
	Head First, Supine	S/1 L/R P/A Start 120.8 RL9 A12.5 End S0.8 RL9 A12.5	Total # Slices: 10 Max # Slices: 11 # of Acqs: 1 Rel. SNR(0): 100	Correction: None	Shim: Auto RF Drive Mode: Quadr Phase Correct: On Table Delta: 0.00
	2D Gradient Echo MPh, EPI Anatomical Region Brain Coil: RM:Nova32ch	Chem SAT: Fat 💌		Minimum TE 12.3	
	U Image Manipulation Prog iew Image Layer Colors	w8-SAR 0.23 B ₁ ,RMS: 0.90µT Mode: First ram 1 🔀 Tools Filters Windows Help		Maximum TE:43 ul. R1=13 R2=15 TG=136 AX=127	7759801

• Erase the default Rx (10 visible slices) and copy the full (60 slice) Rx from the CFMRI fwd ABCD series



- Copying this Rx will keep the location consistent across topup and fMRI scans, which is critical for the success of your imaging session
- After the slice coverage is successfully copied from the topup scan, reduce the number of visible slices to the original parameter setting (10 slices)
- The duration of your fMRI scan can be adjusted using Phases per Location on the console (Multi-Phase tab)
 - The total scan time for your scan is calculated by TR x number of Phases per Location
 - IMPORTANT: The first 2 x Multiband Factor (2 x 6 (ABCD MB factor) = 12) reps will not be included in your f
 - * 12 reps x 1000 ms (TR) = 9.6 seconds of data not included in the final dataset
 - * The timing of your stimulus presentation must be designed with this in mind

	8:	s_							
9030 C_CFM Exam Edit	IRI_ABCD_Scan_Sessi	ion 25:20 End	DISCOVERY MR750 3T Ex: 9030 Se: 1	S 159		fari3te abod	DISCOVERY MR750 3T Ex: 9030 Se: 1	S 159	fwr13 ek
	eries Data		In: 30 Cor A15.0			abod	In: 18 Sag L5.0		ab ab
# Status	Description	S Time			10	c 18 2017 :41:03 AM Mag = 1.0			Dec 18 20 10:41:03 Mag = 1
	1: 3Plane_Loc_SSFSE	00:30							
2 Done	2: CFMRI fwd ABCD	00:17							
3 Done	3: CFMRI rvs ABCD	00:17							
4 InRx	rsfMRI_Run_#1	05:13	R			L	A		
5	rsfMRI_Run_#2	05:13	1 5 ¥			15	}		
6	DTI pe0	07:27 07:27	9	_		9	9		1
			SSF9E TR:822 TE:82,6/EF EC:1/1 83,304z Pf0/32x32 19.42tHx/0.0sp/C 3280102/0.56 NEX ARC/CD/50				SSFSE TR:822 TE:82.6/EF EC:1/1 83.3kHz RM:Nous32ch F0V:3242 10.0bHz/0.0sp/C 36/00:30 298K192/0.56 NEX		
				I 159	W = 2546		/Acc/ED/SQ	I 159	N = 1395 L = 6
Setup	Add Task 🕨	Run	rsfMRI_Run_#1	GRx	€×.	5:13 🔳	Details Multi-Phase	Advanced	
View	R.	esearch Mode	Scan Plane: Axial	•	Freq. Dir. R/L	•	# of TE(s)per 1.0		Frequency: 90 💌
	See		Freq. FOV: 21.6		TR: 800.0		Num Shots: 1		Phase: 90 💌
Auto Scan		_	Phase FOV: 1.00		# Slices: 10		G	raphic Rx Too	olbar
	Save Rx		Slice Thickness: 2.4				Locs SAT Shim		
			Spacing: 0.0				Correction: NONL		COLECCION MODEL SELECCI.
	4) <u></u>		S/I L/R		tal # Slices: 10		Intensity Filter: None	-	Shim: Auto 💌
	Head First, Supine		Start 120.8 R1.9	A12.5	ax # Slices: 13 # of Acqs: 3		3D Geometry Correction:		RF Drive Mode: Quadr 💌
	Imaging			<u> </u>	Rel. SNR@Q: 100	•			Phase Correct: On
	Options		End S0.8 R1.9	A12.5					Table Delta: 0.00
	2D Gradient Echo MPh, EPI								
			Chem SAT: Fat	•					
	Anatomical Region		Contrast:						
	Brain								
	Coil: RM:Nova32ch		WB-SAR: 0.23 B ₁₊ RMS: 0.90µT	Mode: First	dB/	dt: First	Minimum TE 12.3 Maximum TE 43		
	NU Image Manipulation View Image Layer Co		ters Windows Help		Auto Prescan s	uccessfi	ul. R1=13 R2=15 TG=1	36 AX=1277	759801

• When you are ready to save the Rx, check the scan time to ensure it is an accurate reflection of the expected acquisition time

- Save Rx->Scan

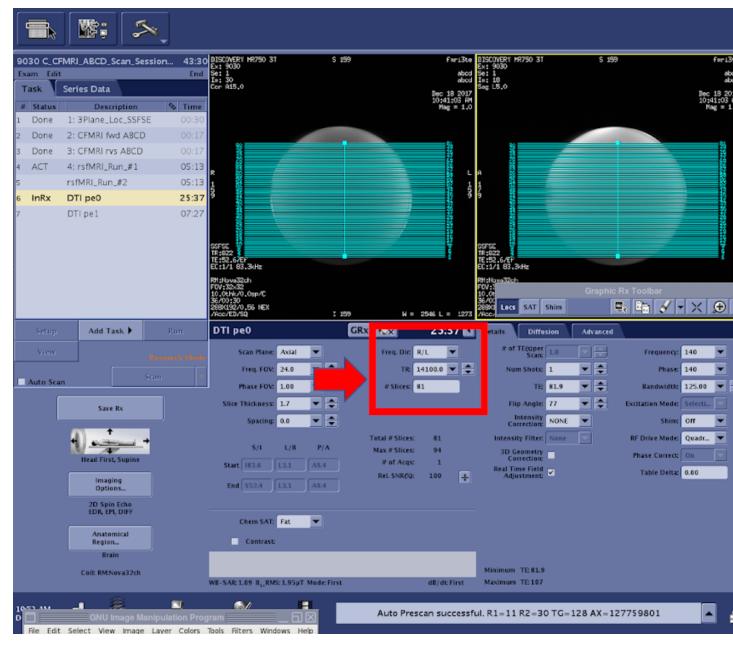
Data Acquisition: Diffusion Tensor Imaging (DTI)

DTI pe0 (7:27)

- The multiband ABCD DTI sequence acquires 81 total slices using a multiband factor of 3
- Using the current GE MR750 software only 27 of the 81 slices are visible during the final Rx setup phase

Exam Edit	FMRI_ABCD_Scan_Session		S 159 F	nri3te DISCOVERY MR750 3T Ex: 9030 abod Se: 1_	S 159 fwr1
Task	Series Data	End Se: 1 In: 30 Cor A15.0	Dec 1	abod In: 18 Sag L5.0 9 2017	a a Dec 18 2
# Status		b Time		:03 AM = 1.0	10:41:03 Mag = 1
1 Done	1: 3Plane_Loc_SSFSE	00:30			
2 Done 3 Done	2: CFMRI fwd ABCD 3: CFMRI rys ABCD	00:17			
4 ACT	4: rsfMRI_Run_#1	05:13			
5	rsfMRI_Run_#2	05:13 R			
6 InRx	DTI pe0	07:27		§ 2	
		SSFSE TR:822 TE:82,6/EF EC:1/1,83,3kHz RM:Nova32ch F0V:32x32 10,0tHx/0,0sp/C		SSFSE IR:822.6/EF ED:11/1 63,3/Hz RttHous32ch FOY:3 36/00 288/01 Locs SAT Shim	Graphic Rx Toolbar
		36/00:30 286X192/0.56 NEX /Acc/ED/50	I 159 W = 2546 L =	36/00 298Ki Locs SAT Shim	🗣 🏝 🖌 • 🗙 🗩
Setup	Add Task 🕨 🛛	un DTI pe0	GRx 🕵 7:2		Advanced
View	Bases	Scan Plane: Axial	Freq. Dir. R/L	# of TE(s)per 1.0	Frequency: 140 💌
		Freq. FOV: 24.0	TR: 4100.0	Num Shots: 1	Phase: 140 💌
Auto Sca	n Scan	Phase FOV: 1.00	• # Slices: 27	TE 81.9	Bandwidth: 125,00 🗸
ĺ	Save Rx	Slice Thickness: 1.7		Flip Angle: 77	Excitation Mode: Selecti
		Spacing: 0.0		Correction: NONE	Shim: Off
	A)	S/1 L/R	Total # Slices: 27	Intensity Filter: None	RF Drive Mode: Quadr 💌
		S/I L/R	P/A Max # Slices: 27	3D Geometry	Phase Correct: On
	Head First, Supine	from [122.7] [12.3] [4	# of Acqs: 1	Correction:	rikse conecc_on
			9.4 # of Acqs: 1 Rel. SNRØQ: 100 9.4	Eorrection: Real Time Field Adjustment:	Table Delta: 0.00
	Head First, Supine Imaging Options 2D Spin Echo		Rel. SNR(Q: 100	Real Time Field	
	Head First, Supine		Rel. SNRØQ: 100	Real Time Field	
	Head First, Supine Imaging Options 2D Spin Echo	End 56.5 L3.1 A	Rel. SNRØQ: 100	Real Time Field	
	Head First, Supine Imaging Options 2D Spin Echo EDR, EPL, DIFF Anatomical	End S6.5 L3.1 A	Rel. SNRØQ: 100	Real Time Field	
	Head First, Supine	End S6.5 L3.1 A	Rel. SNRØQ: 100	 Real Time Field ✓ Adjustment: ✓ Minimum TE 81.9 	

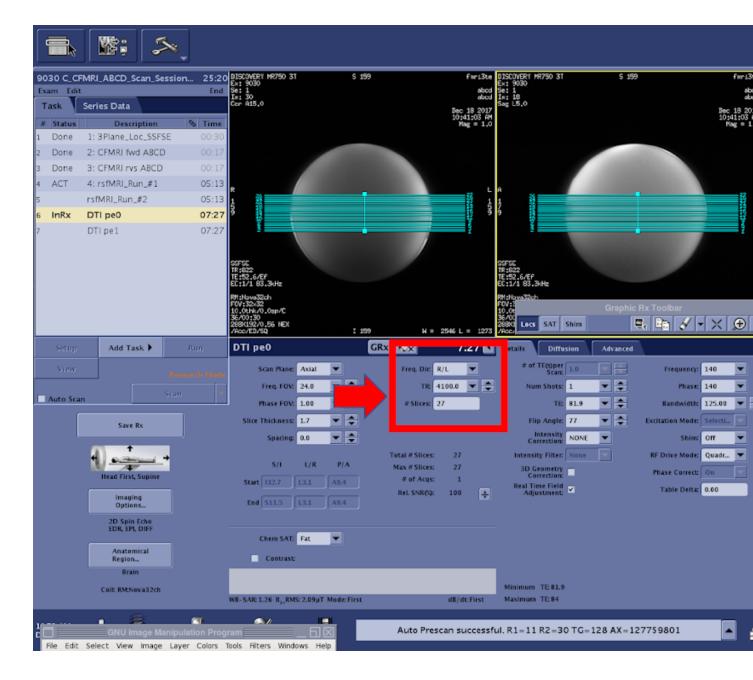
- It is easier to set the Rx and ensure proper anatomical coverage if you can see all of the slices that you will acquire
- This will require temporarily setting the number of slices to 81
- Before changing the number of slices to 81 (total number of slices collected) you must increase the TR dramatically to account for the length of time required to image a larger number of slices (ex: from 4,100 ms to 1,4100 ms)



- Increase TR (4,100 -> 14,100)
- Set the number of slices to 81 (total number of slices collected)
 - If you do not change the TR before editing the number of slices you will receive an advisory error indicating that you have exceeded the maximum number of slices that can be acquired within the current TR
- · Center the slices over the desired coverage area of the brain
- Return # of slices to the original value (27)
- Change TR back to 4,100 ms
 - If you do not return the number of slices to 27 before editing the TR you will receive an advisory
 error indicating that you have exceeded the maximum number of slices that can be acquired within
 the current TR

	8 : S]				
	NUX_HCP_UCSD20151	1 34:51	Ex: 12774	120 fwri3te	DISCOVERY MR750 3T Ex: 12774	\$ 120 fmri3
Exam Edit			Se: 1 In: 25 Cor R16.0	Jacobson, Aaron HCP_prot_Dir	Se: 1 In: 15 Sag L4.0	Jacobson, Aar HCP_prot_D
	ries Data		Cor 11010	Feb 13 2017 11:46:13 AM	Date Color	Feb 13 20 11:46:13
# Status 1 Done 1	Description 3 3Plane Loc SSFSE	S Time 00:24		Mag = 1.0	10	Mag = 1
	TI pe0 mb3 1.7mm	07:00				
	Ti pe1 mb3 1.7mm	07:00				
	MRI mux8 2mm	05:33				
	E EPI topup fwd	00:17	×		A	
	E EPI topup rvs	00:17	8		4	
	IPRAGE PROMO	07:53				
	ube T2 PROMO	06:51				
Setup	Add Task 🕨	Run	Rf13Houa30sh F0Y1354s24 8/0th/X/0.0sp/C 39/00/24 3940(50/7.62 HEX 7heor/E0/50 DTI pe0 mb3 1.7mm	GR. C		I 120 M = 2464 L = 12 dvanced
View			Scan Plane: 🛛 🗮 🔻	Fr <mark>a</mark> . Di	Gr	aphic Rx Toolbar
	Rest	arch Mode	Freq. FOV: 24.0 💌 🚔			🗨 🕰 🖌 🕶 🖉
🗌 Auto Scan	Sean	7	Phase FOV: 1.00 🔻	Accept	Cancel	Bandwidth: 125.00 💌
_			Slice Thickness: 1.7 💌 🚔			Excitation Mode: Selecti
	Save Rx		Spacing: 0.0 💌 🚔		Intensity NONE	
	Read First, Supine		S/I L/R P/A Start 125.3 R6.1 A0.1 End 518.9 R6.1 A0.1	Total # Slices: 27 Max # Slices: 27 # of Acqs: 1 ReL SNR©Q: 100	Intensity File 3D Geometry Correction: Real Time Field Adjustment:	Phase Correct: On Table Delta: 0.00
[Imaging Options 2D Spin Echo		Chem SAT: None 💌			
	EDR, EPI, DIFF					
	Colt RM:Nova32ch				Minimum TE 85.3	
		-	WB-SAR: 1.53 B ₁₊ RMS: 2.31µT Mode: Fire	st dB/dt: First	Maximum TE:90	
11:50 AM February 13		Int: 12773	_ ●∕ ■	*** Reset/D	ownload TPS was successf	ui. •••

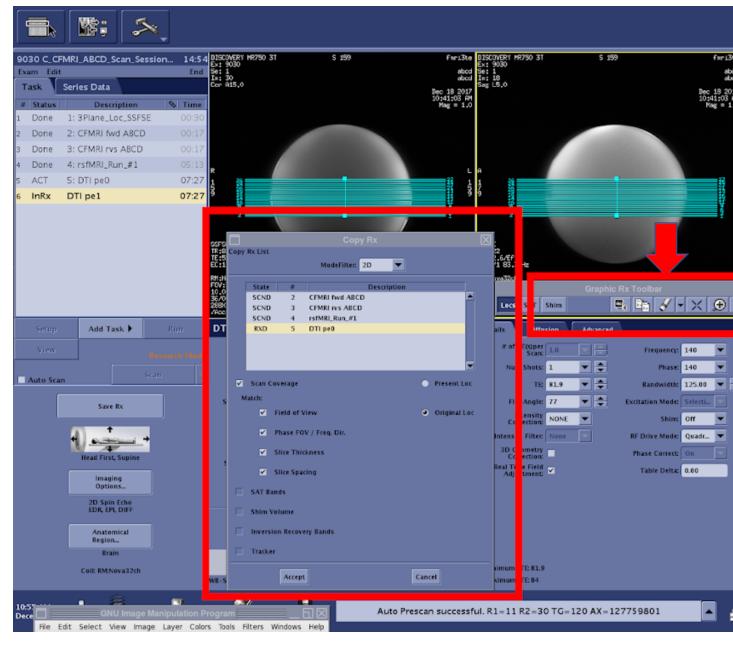
• If the scan time has returned to normal (7:27), you are ready to begin



DTI Distortion Correction Acquisition Option #1:

DTI pe1 (7:27)

- To run the second (pe1) DTI scan you will need to copy the Rx from the previous DTI scan
- Use the Graphic Rx Toolbar



- Select the previous DTI scan Rx
- Save Rx->Scan

DTI Distortion Correction Acquisition Option #2:

DTI_fieldmap (pe1) (~0:50)

- The official ABCD protocol uses an Rx matched, 50 second, reverse phase encoded DTI acquisition to perform distortion of
 - Pros: Reduces total scan session time by ~6 min
 - Cons: All resulting diffusion analyses are based on one ~7 minute acquisition

• The process of running the DTI_fieldmap is identical to the instructions above (DTI pe1)

3.1.2 CFMRI Multiband Protocol #2

Protocol Location and Receiver Coil Info

The CFMRI Multiband Protocol #2 (HCP Lifespan Based) requires the use of the Nova Medical 32 channel head coil The MB Protocol #2 can be found on both the 3T West and 3T East scanners under: * Adult >Template-> C_CFMRI_HCP_LIFESPAN

Pre-Scan Preparation

- Place the 32channel coil on the scanner table and plug it in
- Make sure the coil is recognized by the scanner by checking on the iROC monitor above the patient bed
- Setup peripheral equipment such as the projector, screen, stimulus laptop, etc.
- Setup the subject (blanket, emergency communication device, mirror, etc.) on the scanner patient bed
- Setup physiological monitoring if needed
- Register the subject and "Start Exam"

Data Acquisition: EPI & Topup Distortion Correction

CFMRI fwd HCP-L (~17 sec)

- Magnetic susceptibility and geometric distortion artifacts can be addressed by acquiring two short sequences with opposite phase encoding directions (1. Forward: Anterior–>Posterior, 2. Reverse: Posterior–>Anterior), followed by preprocessing using FSL topup https://fsl.fmrib.ox.ac.uk/fsl/fslwiki/topup
- The HCP-L topup scans should have 72 slices
- The topup scans do not utilize multiband acceleration
- The number of slices you see in the Rx reflects the total acquisition coverage
- Center the slices over the desired location in the brain

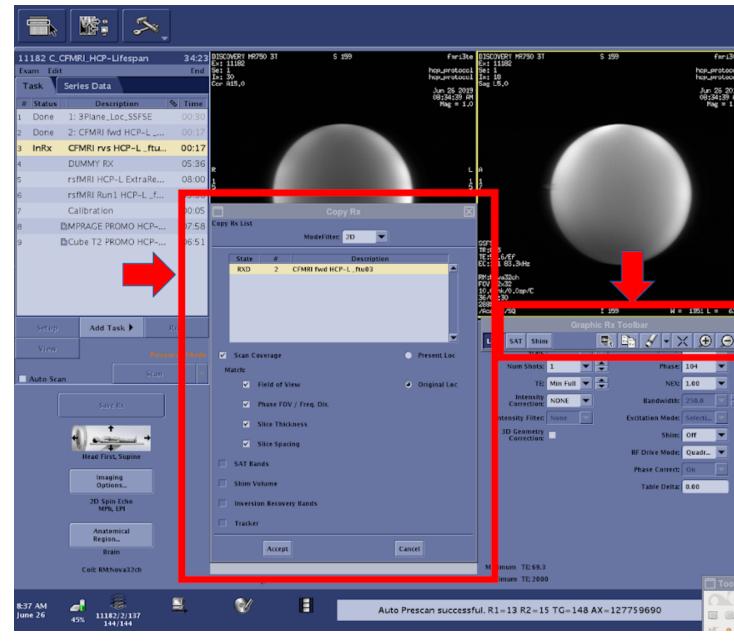
11102 C CEL		24:40	DISCOVERY NR750 31	S 159		Fact 3t	DISCOVERY MR750 31	S 159	far 13
11182 C_CFN Exam Edit	IRI_HCP-Lifespan	34:40 End	DISCOVERY NR750 3T Ex: 11182 Se: 1 In: 30 Cor A15.0	9 199		hcp_protocc	DISCOVERY MR750 3T Ex: 11182 Se: 1	5 109	hap_protoc
	ries Data		In: 30 Cor A15.0			hop_protocc Jun 26 201	In: 18 Sag L5.0		hap_protoci Jun 26 20:
# Status	Description	b Time				08:34:39 F Mag = 1.			08:34:39 (Mag = 1
	3Plane_Loc_SSFSE	00:30							
2 InRx C	FMRI fwd HCP-L _ft	00:17	3			26	78		23
3 C	FMRI rvs HCP-L_ftu04	00:17							
4 D	ummy rx	05:36				li i			
5 rs	fMRI HCP-L ExtraRe	08:00	1				1		
6 rs	fMRI Run1 HCP-L_f	05:36	ş			1	9		
7 C	alibration	00:05				8			
8 🗈 M	PRAGE PROMO HCP	07:58							
9 🖪 C	ube T2 PROMO HCP		SSFSE TR:835 TE:52,6/Ef EC:1/1 83,3kHz			Ĭ	SSFSE TR:835 TE:82,6/Ef EC:1/1 63,3kHz		
			RM:Nova32ch FOV:32232 10.04H:k/0.0ep/C 36/00:30 2860192/0.56 NEX 00-455 65				RM::Nove32ch FOV::22x32 10.0bHk/0.0sp/C 36/00:30 268K192/0.56 NEX		
			286X192/0,56 NEX /Acc/ED/50	I 159	W = 2	2304 L = 115	298K192/0,56 NEX /Acc/ED/SQ	I 159	W = 1351 L = 6
Setup	Add Task 🕨 🛛 🛛	um	CFMRI fwd HCP-L_f	tu03 GR	(🕵	0:17 🕨		Graphic Rx Toolbar	
View			Scan Plane: Axial	-	Freq. Dir. R/	1. 🔻	Locs SAT Shim		<u>e e X - Y</u>
	Resear	rch Mode	Freq. FOV: 20.8		TR 85				Jun 26 20 08:34:39
Auto Scan	Scan	Ψ	Phase FOV: 1.00		# Slices: 72				Mag = 1
					# sinces. 72			-	
	Save Rx		Slice Thickness: 2.0						
	· •		Spacing: 0.0						
	() <u></u>		S/I L/R	P/A	Total # Slices: Max # Slices:	72 72	R		
	Head First, Supine		Start 179.5 L1.2	A3.1	# of Acqs:	1	5		F
	Imaging		Start 179.5		Rel. SNR@Q:	100 🕂			
	Options 2D Spin Echo		End \$62.5 L1.2	A3.1					0111
	MPh, EPI		Cham CAT. Cot				SSFSE TP+875		
	Anatomical		Chem SAT: Fat	•			TE:52.6/EF EC:1/1 83.30		
	Region		Contrast:				RM:Nova32ch		8 <u>-</u>
	Brain						F0V:32x32 10.0thk/0.0sp/C 36/00+30		tank and
	Coil: RM:Nova32ch	1	WB-SAR: 0.55 B3, RMS: 1.37µT M	dode: First		dB/dt First	36/00:30 298K192/0.56 NEX /Acc/ED/SQ	P 139	H = 242
					_				
8:35 AM	. 🏶 🛔		(2)						570

• Save Rx->Scan

- There may be a long (20 sec) pause before the topup scan begins

CFMRI rvs HCP-L (~17 sec)

- To run the second (rvs) topup scan you will need to copy the Rx from the previous topup scan (fwd)
- Use the Graphic Rx Toolbar
 - Select the previous topup (fwd) scan Rx



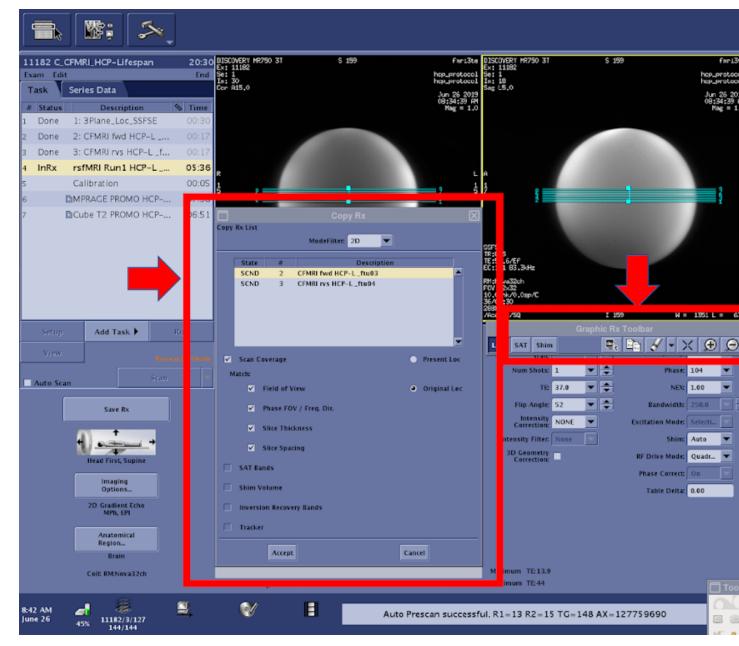
• Save Rx–>Scan

rsfMRI_Run_#(1-4) HCP-L (~5.5 min each)

- The multiband ABCD fMRI sequence acquires 72 total slices using a multiband factor of 6.
- Using the current GE MR750 software available on CFMRI scanners, only 9 of the 72 slices are visible during the final Rx setup phase

	\$; \$								
Exam Edit Task Ser # Status	IRI_HCP-Lifespan ries Data Description	20:30 End Set 1 In: 30 Cor Al5:0	3T S 15	9	Fari3te hcp_protocol hcp_protocol Jun 26 2019 08;34:39 RM Mag = 1.0	DISCOVERY MR/50 3T Ex: 11182 Se: 1 In: 18 Sag L5.0	S 159		Far13 hcp_protoc hcp_protoc Jun 26 20 08;34;39 Mag = 1
2 Done 2: 3 Done 3: 4 InRx rs 5 Ca 6 InM	CFMRI fwd HCP-L CFMRI rvs HCP-L _f f MRI Run1 HCP-L alibration PRAGE PROMO HCP	00:17 00:17 05:36 00:05 07:58			L 169	A 17			S-CD-H
7 B C	ube T2 PROMO HCP	06:51 SSFSE TR:1835 TE:182,6/EF EC:1/1/183,3KHz Philtiona32ch FW:180xa32ch FW:180xa32ch				SSFSE TR:835 TE:122.6/EF EC:1/1.83.3kHz #N:16w32ch F0Y:32x32			
Setup	Add Task 🕨	RH1Hova32ch POV:32x32 36:401:30 26:401:30 28:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR:192:47.56 PR	1 15	GRX Sx	2304 L = 1152 5:36 【	10.0cHk/0.0ep/C 36/00;30 268K192/0.56 NEX /Roc/ED/50 Locs SAT Shim	I 159 Graphic Rx T		1351 L = 6
View Auto Scan	Resea Scan	Freq. F	ne: Axial 20.8 20.8 0V: 1.00	Freq. Dir: R TR: 8 # Slices: 9		Num Shets: 1 TE 37.0		Phase: 1	04
	Save Rx	Slice Thickne Spaci	ss: 2.0 V	Total # Slices:	9	Flip Angle: 52 Intensity Correction: NON Intensity Filter: None	_	Bandwidth: 2 Excitation Mode: 5 Shim: 7	ielecti 🔽
	Head First, Supine	S/I Start 116.5 End 10.5	L/R P/A	Max # Slices: # of Acqs: Rel. SNR(Q:	9 1 100 +	3D Geometry Correction:		RF Drive Mode: 0 Phase Correct: 0 Table Delta: 0	Quadr 👻 Dn 💌
	2D Gradient Echo MPh, EPI Anatomical Region	Chem S						Table Deita: U	
	Brain Coil: RM:Nova32ch		RMS: 0.85µT Mode: First		dB/dt First	Minimum TE13.9 Maximum TE44			Too
June 26	5% 11182/3/127 144/144	<u> </u>		Auto Preso	an successfi	ul. R1=13 R2=15 TG	=148 AX=12	7759690	

• Erase the default Rx (9 visible slices) and copy the full (72 slice) Rx from the CFMRI fwd ABCD series

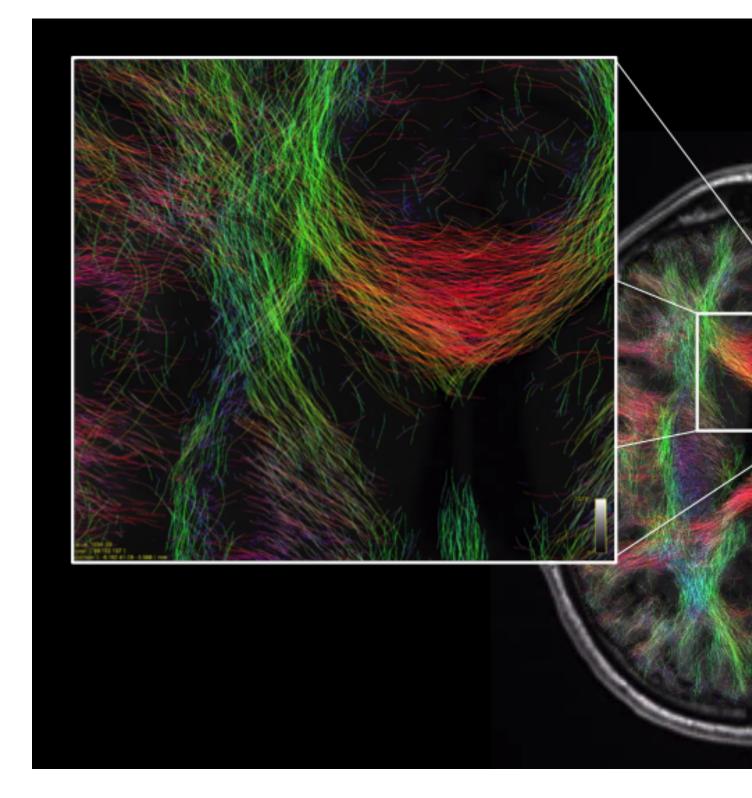


- Copying this Rx will keep the location consistent across topup and fMRI scans, which is critical for the success of your imaging session
- After the slice coverage is successfully copied from the topup scan, reduce the number of visible slices to the original parameter setting (10 slices)
- The duration of your fMRI scan can be adjusted using Phases per Location on the console (Multi-Phase tab)
 - The total scan time for your scan is calculated by TR x number of Phases per Location
 - IMPORTANT: The first 2 x Multiband Factor (2 x 6 (ABCD MB factor) = 12) reps will not be included in your final dataset * 12 reps x 1000 ms (TR) = 9.6 seconds of data not included in the final dataset * The timing of your stimulus presentation must be designed with this in mind

	CFMRI_HCP-Lifespan	20:30	DISCOVERY MR750 3T Ex: 11182 Sat 4	S 159		far13te	Eve 11182	S 159		fnri
Exam Edit		End	Se: 1 In: 30 Cor A15.0			hop_protocol hop_protocol	Se: 1 In: 18 Seg L5.0			hop_proto hop_proto
Task	Series Data		COL HISTO			Jun 26 2019 08;34;39 AM				Jun 26 2 08;34;39
# Status 1 Done	Description 1: 3Plane_Loc_SSFSE	S Time 00:30				Mag = 1.0				Mag =
2 Done	2: CFMRI fwd HCP-L	00:17	**			=71				71
3 Done	3: CFMRI rvs HCP-L_f	00:17								
4 InRx	rsfMRI Run1 HCP-L	05:36				. R				
5	Calibration	00:05	1			1	1			
6	MPRAGE PROMO HCP	07:58	9			<u>ş</u>	é			
7	Cube T2 PROMO HCP		S6FSE TR:835 TR:23,6/EF EC:1/1 63,3/4/2		Ŧ		SSFSE TR:835 TE:52,6/EF EC:1/1 83,3%Hz			
			RM:Nova32ch F0V;32x32 10.0thk/0.0sp/C 36/00;30 286X192/0.56 NEX /Rcc/ED/5Q	I 159	И = 1	2304 L = 1152	RH:Nova32ch F0V;32x32 10.0cHk/0.0sp/C 36/00;30 268K192/0.56 NEX /Acc/ED/SQ	I 159	н =	1351 L =
Setup	Add Task 🕨	Rum	rsfMRI Run1 HCP-	L G	Rx 🕵 🛪	5:36 💽		Graphic Rx 1	Foolbar	
View		and to be transfer	Scan Plane: Axial	•	Freq. Dir. R	/L 🔻	Locs SAT Shim			
		arti mode	Freq. FOV: 20.8	-	TR 8	00.0 🔻 ≑	Num Shots: 1	-	Phase:	104 💌
Auto Sca	n Scaro	*	Phase FOV: 1.00	-	# Slices: 7	2	TE 37.0		NEX	1.00 💌
ſ	Site Br		Slice Thickness: 2.0				Flip Angle: 52		Bandwidth:	250.0
Ļ			Spacing: 0.0				Intensity NONE	•	Excitation Mode:	Selecti 🔽
					Total # Slices:	9	Intensity Filter: None		Shim:	Auto 💌
	Head First, Supine		S/I L/R	P/A	Max # Slices:	9	3D Geometry Correction:		RF Drive Mode:	Quadr 💌
			Start 179.5 L1.2	A3.1	# of Acqs: Rel. SNR@Q:	1			Phase Correct:	On 💌
	Imaging Options		End \$62.5 L1.2	A3.1					Table Delta:	0.00
	2D Gradient Echo MPh, EPI Anatomical Region		Chem SAT: Fat	¥						
	Brain									
	Coil: RM:Nova32ch				be decreased to 256		Minimum TE:13.9			
		1	WB-SAR: 0.21 B ₁₊ RMS: 0.85p	T Mode: First		dB/dt:First	Maximum TE:44			🗖 То
8:43 AM June 26	45% 11182/3/127 144/144	₽,	V		Auto Preso	an successfi	ul. R1=13 R2=15 TG=	148 AX=12	7759690	

• When you are ready to save the Rx, check the scan time to ensure it is an accurate reflection of the expected acquisition time (TR x Phases per location) * Save Rx->Scan

3.1.3 Diffusion Tensor Imaging User Guide



Introduction

CFMRI supports the following 3 non-multiband DTI protocols

	Protocol #1	Protocol #2		
Number of Scans	1 DTI scan	2 DTI scans		
Typical Scan Time	3-10 min	6-20 min		
Resolution	2x2x2 mm	2x2x2 mm		
Pros	Only 1 scan is required. Short scan time	Optimal distortion correction. Ability to use ASSET		
Cons	Will not work with ASSET, which leads to reduced slice coverage per unit time	Scan time is doubled due to the requirement for two separate scans		
Recommendation to Use	Use for simple protocol setup and acquisition	Dest to use when scan time is not a limiting factor and the best distortion correction results are desired		
*Note # of DTI slices must be even				

Protocol #1

Description

Protocol #1 consists of DTI acquisition: "DTI-TOPUP"

- By default Protocol 1 acquires two T2 (or b=0) images at the beginning of the scan
- The first T2 image uses reversed phase encoding direction, whereas the second T2 image and the subsequent diffusion weighted images use forward phase encoding direction
- Due to the requirement of opposite phase encoding directions, the number of T2 images must be 2 or greater.

Location of the Protocol

Adult -> Templates -> DTI_TOPUP The protocol is available on both 3T West and 3T East scanners.

Parameters

- User should adjust b value and number of directions to fit study needs
- Other parameters to customize include: FOV, slice thickness, number of slices (must be even), TR, and matrix size.

Advanced Options

The following CVs are set under the advanced tab and can be customized as needed:

CV1: pepolar = 2 or 3 (do not set to 0 or 1)

- The pepolar parameter controls the phase encoding direction, i.e. pepolar = 2 corresponds to forward phase encoding, whereas pepolar = 3 corresponds to reverse phase encoding
- In a typically MRI setup, forward phase encoding causes compression of the frontal lobe and stretching of the occipital lobe; whereas reverse phase encoding causes stretching of the frontal lobe and compression of the occipital lobe
- Since stretching is easier to correct than compression, one could choose this parameter accordingly for the specific areas of brain being studied
- CV2: rhmethod = 1
 - prevent interpolation to 256 in the reconstructed images)

CV4: ssgr fat suppression = 1

• reverses spin echo refusing gradient polarity to better suppress fat signal

Shim Settings and Scan Instructions

Shim is set to Auto. After saving Rx, press Scan to start.

Protocol #2

Description

Protocol 2 consists of two DTI acquisitions: "DTI-fwd" & "DTI-rvs"

- The DTI-fwd scan acquires data in forward phase encoding direction, whereas the DTI-rvs scan acquires data with reversed phase encoding direction
- All parameters must match between the two scans except the phase encoding direction
- This protocol is also available with ASSET option ON.

Location of the Protocol

Adult -> Templates -> DTI_TOPUP The protocol is available on both 3T West and 3T East scanners.

Parameters

- User should set the number of T2 images, the number of diffusion directions and b value as desired
- The same parameters must be applied to both scans
- Other parameters to customize include: * FOV * Slice thickness * Number of slices (must be even) * TR * Matrix size
- The same parameters must be applied to both scans

Advanced Options

The following CVs are set under the advanced tab and can be customized as needed:

- CV2: rhmethod = 1 * Prevent interpolation to 256 in the reconstructed images
- CV4: ssgr fat suppression = 1 * Reverses spin echo refusing gradient polarity to reduce remaining fat signal

Shim Settings and Scan Instructions

The order of the two scans can be swapped. However, the first scan can have shim set to Auto and the second scan must have the shim set to OFF.

For each scan, save Rx and press Scan.

Protocol #2

Description

Protocol 3 consists of three DTI acquisitions: "DTI", "DTI_cal_fwd" & "DTI_cal_rvs"

- The first two scans of this protocol are calibration scans with forward and reversed phase encoding directions respectively * They are used to estimate the field map, which is then applied to the DTI scan to correct distortions
- The subsequent DTI can be any DTI scan (i.e, either GE standard DTI or the DTI supplied with this protocol)
- The only requirement is that the Rx info must match among all three scans, e.g. FOV, slice thickness, number of slices and matrix size
- This protocol is also available with ASSET option ON

Location of the Protocol

Adult -> Templates -> DTI_TOPUP The protocol is available on both 3T West and 3T East scanners.

Parameters

For the two calibration scans, user may customize: * FOV * Slice thickness * Number of slices (must be even) * TR * Matrix size Please keep in mind that Rx information must match the DTI scan.

For the DTI, user should set: * Number of T2 images * The number of diffusion directions * b value.

Other parameters to customize include: * FOV * Slice thickness * Number of slices (must be even) * TR * Matrix size

Remember that the Rx info of the DTI scan must match the Rx info of the calibration scans

Advanced Options

User should not change any advanced options in the calibrations scans.

For the DTI scan, if you are using the GE standard DTI, no change should be made in the advanced tab

If you are using the DTI supplied with this protocol, the following CVs under the advanced tab can be customized as needed:

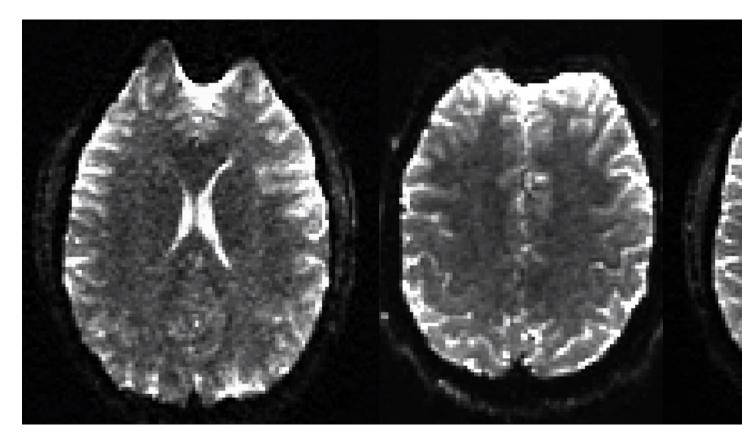
- CV1: pepolar = 0 or 1 (do not set to 2 or 3) * The pepolar parameter controls the phase encoding direction, i.e. pepolar = 0 corresponds to forward phase encoding, whereas pepolar = 1 corresponds to reverse phase encoding * In a typically MRI setup, forward phase encoding causes compression of the frontal lobe and stretching of the occipital lobe; whereas reverse phase encoding causes stretching of the frontal lobe and compression of the occipital lobe * Since stretching is easier to correct than compression, one could choose this parameter accordingly for the specific areas of brain being studied
- CV2: rhmethod = 1 * To prevent interpolation in the reconstructed images
- CV4: ssgr fat suppression = 1 * Reverse spin echo refusing gradient polarity to reduce remaining fat signal

Shim Settings and Scan Instructions

The order of the two scans can be swapped. However, the first scan can have shim set to Auto and the second scan must have the shim set to OFF.

For each scan, save Rx and press Scan.

DTI TOPUP Distortion Correction



Required Software

We provide a C-Shell script "processtopup" for processing the data acquired with the above protocols.Processtopup first prepares the GE dicom data and converts it into NIFTI format and then calls the TOPUP tool from FSL to unwarp the distortion. More information on the FSL TOPUP tool is available at the FSLwiki website (http://fsl.fmrib.ox.ac. uk/fsl/fslwiki/topup).

- 1. Processtopup (http://fmri.ucsd.edu/download/processtopup)
- 2. AFNI (http://afni.nimh.nih.gov/afni/)
- 3. FSL version 5.0 or above (http://fsl.fmrib.ox.ac.uk/fsl/fslwiki/)
- Environment Variable FSLOUTPUTTYPE must be set to NIFTI_GZ
- Environment Variable FSLDIR must be set and point to the FSL installation folder
- The acquired DTI data must have an even number of slices (requirement of the FSL TOPUP tool) * If the number of slices is odd, processtopup will remove the last slice from the data

Usage

processtopup -dsnum <num of DTI dir> -d1 <data dir> [-d2 <data dir> -d3 <data dir> <options>] -o <outstem>"

Required Inputs

-dsnum <number of DTI data directories, 1, 2 or 3>

if -dsnum 1 -d1 <DTI data dir>

if -dsnum 2 -d1 <DTI_fwd data dir> -d2 <DTI_rvs data dir>

if -dsum 3 -d1 <Cal1_dir> -d2 <Cal2_dir>" -d3 <DTI data dir>

Note: The -d1 and -d3 inputs must have the same phase encoding direction;

-o <unwarpped filename stem>"

Optional Inputs

-tmpdir : specify tmp dir name -nocleanup : disables removal of temporary files

Output

<outstem> - unwarpped volume filename stem

Examples

Protocol 1: >>processtopup -dsnum 1 -d1 dti_dir -o myoutput

Protocol 2: >> processtopup -dsnum 2 -d1 dti_fwd -d2 dti_rvs -o myoutput

Protocol 3: >> processtopup -dsnum 3 -d1 cal_fwd -d2 cal_rvs -d3 dti_fwd -o myoutput

For questions about this manual, please contact Aaron Jacobson (ajacobson@ucsd.edu)

3.1.4 Arterial Spin Labeling User Guide

Background

- At CFMRI, we strive to provide the state-of-the-art arterial spin labeling (ASL) protocols for a quick and robust measure of whole brain cerebral blood flow (CBF).
- As of May 1, 2015, we have updated our existing ASL protocols to ensure that the scan parameters are in compliance with those recommended by the ISMRM Perfusion Study Group1.
- In addition to the standard acquisition parameters, we now provide two additional subsets of parameters optimized for pediatric and geriatric populations.
- The scans for each protocol are also more streamlined, making them easier to execute and less prone to operator error.
- For questions about the ASL protocols, please contact Conan Chen (coc004@ucsd.edu).

ASL FAQs

- What is ASL?
- What types of ASL protocols are available at CFMRI?
- What is new as of the May 1, 2015 update?
- Where do I find the updated CFMRI ASL protocols?
- How do I transfer data acquired from the scanner?
- How do I process data once the data are acquired?
- Between FAIR and PCASL, which one should I use?

- Between 2D PCASL and 3D PCASL, which one should I use?
- What are the standard scan and labeling parameters for each protocol?
- Is there an ASL protocol I can use for functional studies?
- What other ASL techniques are out there?

What is ASL?

Healthy brain function is critically dependent on well-regulated CBF for the delivery of oxygen and glucose. Regional alterations in CBF have been observed in a wide range of health conditions, including acute and chronic cerebrovascular disease (e.g. stroke, transient ischemic attacks), Alzheimer's disease, mild cognitive impairment, epilepsy, HIVrelated cognitive impairment, multiple sclerosis, depression, schizophrenia, post-traumatic stress disorder, traumatic brain injury, obsessive-compulsive disorder, and vascular dementia. Over the past decade, ASL has emerged as a robust and non-invasive method for acquiring regional CBF maps. Because of its non-invasive nature and ease of use, a growing number of research and clinical sites are now using ASL.

What types of ASL are available at CFMRI?

We provide both FAIR2 and Pseudocontinuous ASL1 (PCASL) protocols.

What is new in ASL at CFMRI?

- 1. In addition to the existing CFMRI 2D PCASL, we now support GE 3DASL.
- 2. The CSF scan is now part of the ASL scan and thus is no longer needed as a separate acquisition (no need to remember to run manual prescan!).
- 3. Introduced a 10-minute 2D PCASL protocol with background suppression optimized for measurements of whole brain white matter CBF3.
- 4. Introduced a single-click multi-TI transit delay mapping protocol (PCASL) that provides a whole brain T1 map, transit delay map, and a quantified CBF map in 15 minutes4.
- 5. After the ASL/CSF scan, a MATLAB script is automatically invoked and the quantified CBF map is displayed on screen to provide immediate feedback on data quality.
- 6. In order to account for variance in transit delays among different study groups, acquisition parameters have been optimized for each (see below).

2D PCASL			
Groups	Labeling Duration	Post Labeling Delay	Comments
Standard	1800 ms	1800 ms	Recommended for healthy adults
Pediatrics	1800 ms	1500 ms	Recommended for children less the
Geriatrics	1800 ms	2000 ms	For healthy adults > 70 y. Also for
White Matter	1900 ms	1900 ms	Use background suppression to in pulses 1570 ms and 350 ms prior
2D FAIR		•	
Groups	Tag Width/Gap	TI1/TI2	PLD (TI2-TI1)
Standard	15 cm/1 cm	800 ms/1800 ms	1000 ms
Pediatrics < 15 yr	10 cm/1 cm	600 ms/1600 ms	1000 ms

Where do I find the updated CFMRI ASL protocols?

The latest ASL protocols are available both on the 3TW and 3TE scanners under

• Adult->Templates-> * C_ASL_2DFAIR * C_ASL_2DPCASL * C_ASL_3DPCASL

Note: Individual scans under each protocol can be selected and imported into your own protocol.

For each of the protocols selected, users will find a note associated with the ASL scan (see red box in the figure above) that describes how to prescribe the imaging volume

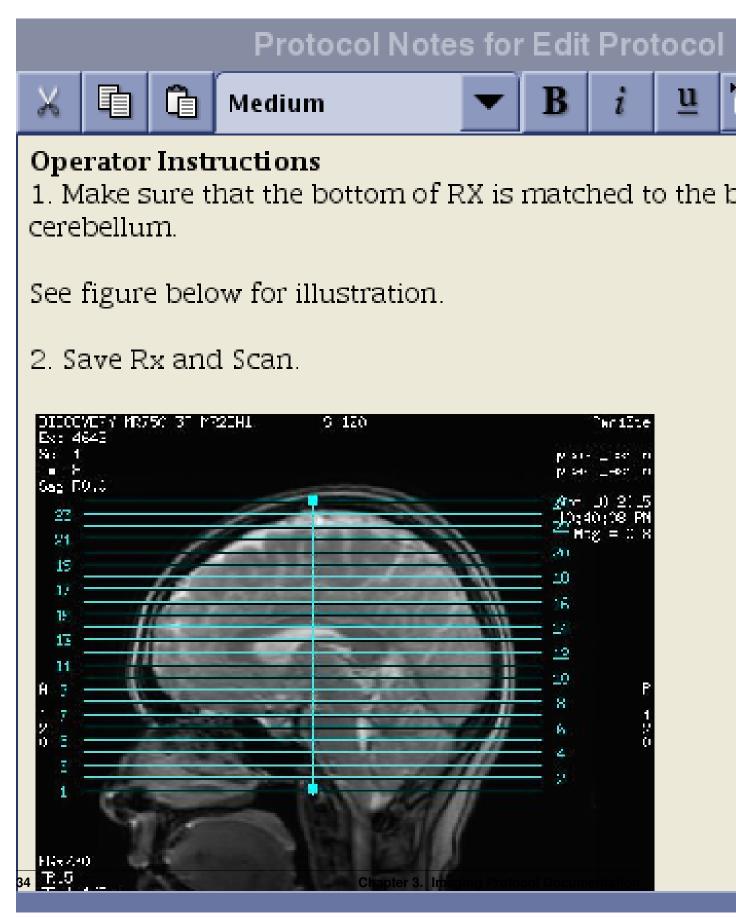
How to see the Protocol Note:

• Set up a patient and select an ASL protocol

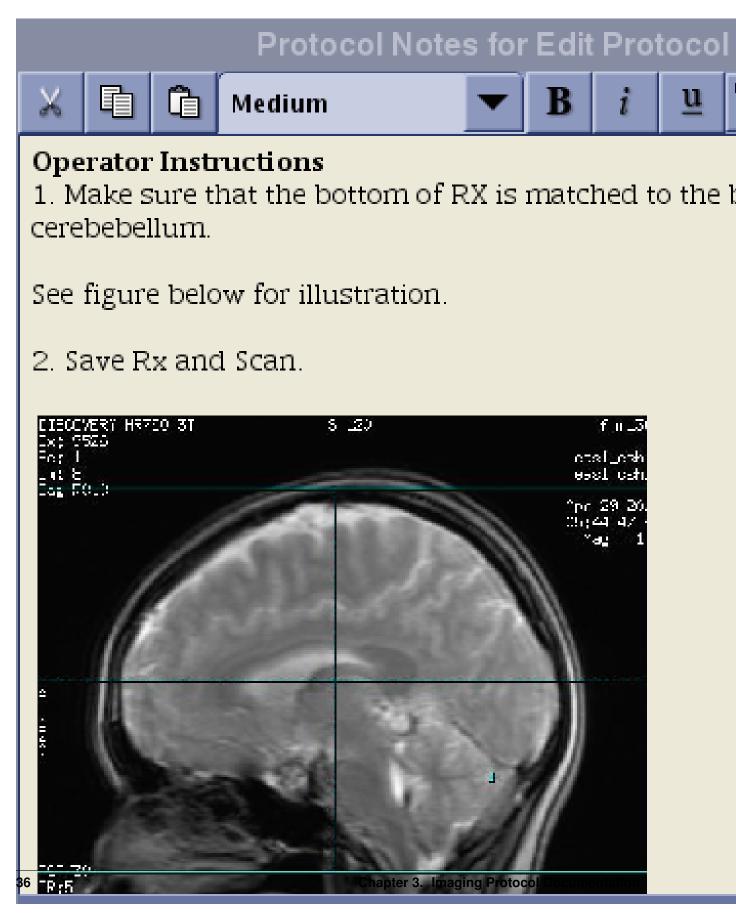
- Select a desired ASL series in the Work Flow Manger List Window by a single mouse click on the series and then click on Set Up.
- The note will appear directly on the scan prescription page at the right bottom corner (see Figure below).

Below are the screenshots of the note for each protocol.

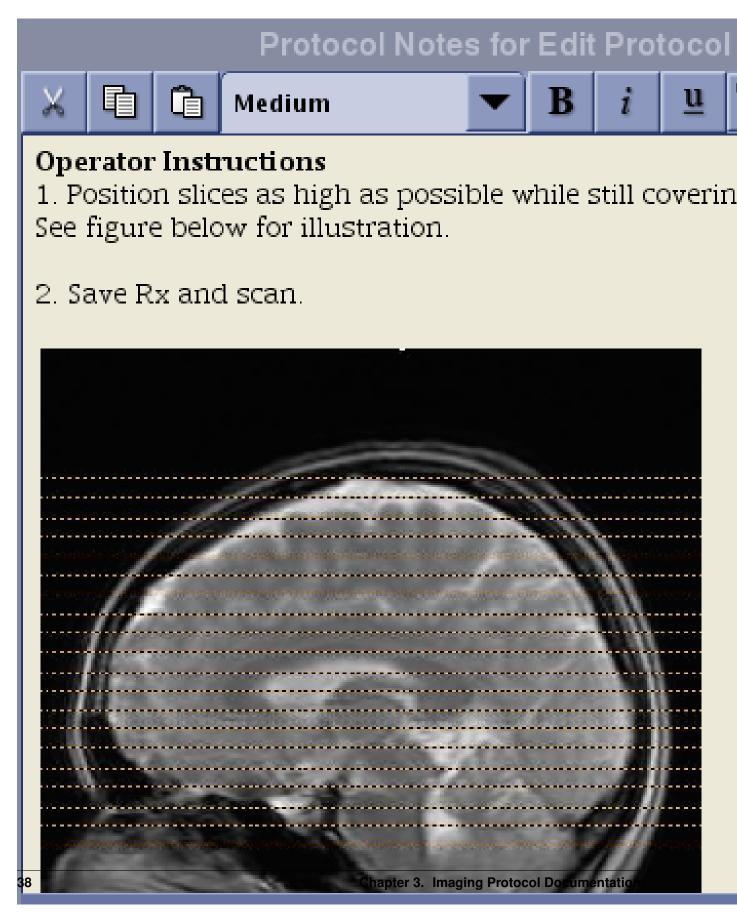
2D PCASL Protocol Coverage



3D PCASL Protocol Coverage



FAIR Protocol Coverage



Note: The prescription instruction for the FAIR protocol is different from that of the PCASL protocols!

N.B. If you erase the default graphic prescription preloaded with the protocol, make sure to position the first line of the graphic tool from the bottom and add slices toward the top. For ASL, the slices must be acquired from bottom to top for proper quantification. Do not place the first line of the graphic tool at the top and extend slices toward the bottom of the head!

How do I transfer data acquired from the scanner?

For all protocols other than GE 3DPCASL, the scanner outputs images in GE Pfile format (e.g. P34816.7).

To locate and transfer Pfiles to another server, see example below:

```
{sdc@fmri3tw}[107] cd /usr/g/mrraw/
Directory: /usr/g/mrraw
{sdc@fmri3tw}[108] ls -ltr P*
-rwxrwxr-x 1 sdc informix 135423580 2015-05-07 12:17 P31232.7*
-rwxrwxr-x 1 sdc informix
                        6873036 2015-05-07 12:18 P31744.7*
                                                         Your Pfiles
-rwxrwxr-x 1 sdc informix 7047403 2015-05-07 12:19 P32256.7*
-rwxrwxr-x 1 sdc informix 123723044 2015-05-07 16:07 P34816.7*
-rwxrwxr-x 1 sdc informix 270457395 2015-05-07 16:13 P35328.7*
-rwxrwxr-x 1 sdc informix 8070354 2015-05-07 16:14 P35840.7*
{sdc@fmri3tw}[110] scp -p P34816.7 marybirn@fmriserver.ucsd.edu:~/data/subjectfolder
UC San Diego - Center for Functional MRI
               Authorized access only!
                                                     #
# Disconnect IMMEDIATELY if you are not an authorized user!!!
        All actions Will be monitored and recorded
marybirn@fmriserver.ucsd.edu's password:
```

If you have several Pfiles to transfer, it may be easier to use the pcopy.pl script that allows you to transfer files in batch.

Example of how the script can be used is shown below.

```
{sdc@fmri3tw}[107] pcopy.pl
This program will allow you to copy P files within the last 24 hours with a time range.
Usage: pcopy.pl
      [options]
      -s [fmriserver] server name
                    directory name if created on server
      -d [ ]
Example: pcopy.pl -s fmriserver -d norm040104 <10:00:00> <18:30:00> pywong
Please email problems to pywong.edu
{sdc@fmri3tw}[108] pcopy.pl -s fmriserver -d subject1folder 16:05 16:15 marybirn
Servername = fmriserver
Directory name = subject1folder
P35328.7 Thu May 7 16:13:23 2015
P34816.7 Thu May 7 16:07:42 2015
                                                    Choose time range here for batch transfer
P35840.7 Thu May 7 16:14:15 2015
Are you sure you want to copy the files listed above? <yes> or <no>
yes
mycommand = scp -p /usr/g/mrraw/P35328.7 /usr/g/mrraw/P34816.7 /usr/g/mrraw/P35840.7 marybirn@fmr
UC San Diego - Center for Functional MRI
                Authorized access only!
# Disconnect IMMEDIATELY if you are not an authorized user!!! #
        All actions Will be monitored and recorded
marybirn@fmriserver.ucsd.edu's password:
```

For 3DPCASL, T1 structural, and field map scans, data are stored in DICOM format.

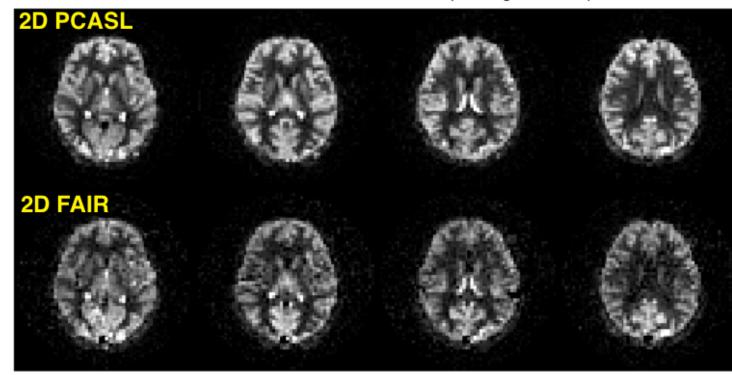
Refer to this link for instructions on how to move DICOM files from the scanner to another server.

Between FAIR and PCASL, which one should I use?

PCASL is a newer technique that provides several advantages over FAIR. Unless you have an ongoing ASL study using the FAIR protocol, we currently recommend all new users to choose the PCASL protocols.

FAIR and 2D PCASL CBF maps acquired from the same subject are shown below.

Baseline CBFs (ml/100g tissue/min)



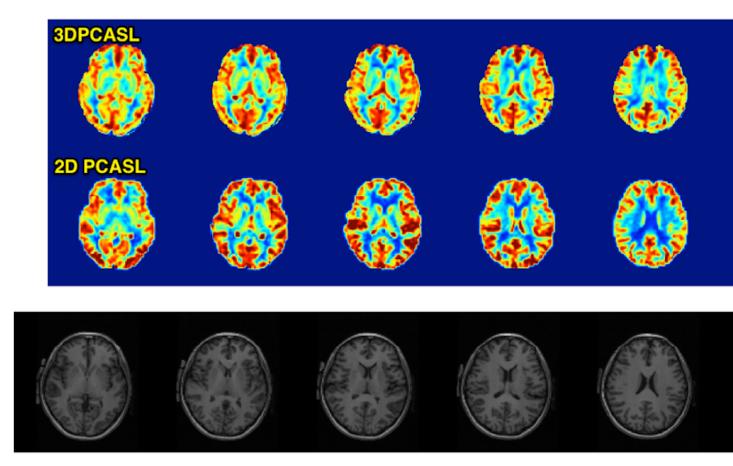
Between 2D PCASL and 3DPCASL, which one should I use?

Use the table below to assess the pros and cons of each protocol.

		2D PCASL	GE 31
	PROS	 Less sensitive to head motion and can be corrected retrospectively 	 Single scan
		 Provides temporal changes in CBF over time, amenable to conventional fMRI and resting state fMRI studies 	 System-built data proc Higher SNR
		 Temporal filtering can be used to remove physio noise from perfusion signal 	 Higher spatial resolutio
		 More flexible post processing options and CBF quantification methods available via the CBFBIRN 	 Post labeling delay fixe
		 Requires 1:30 minutes of prescan 	 Sensitive to head motion correction is currently r
	CONS	 Field mapping is recommended to correct for blurring/signal dropouts in spiral images, which requires additional 1:15 min of scan time 	 Suffers from through-p overestimate white mar
	0	 Longer reconstruction time (if field map correction is used on the CBFBIRN) 	 Not compatible with fM changes over time are
		 Post labeling delay varies across slices 	 Background suppression perfusion signal, which quantification
	Comments	 If your subject population (e.g. young children) is prone to head motion, this protocol is recommended 	 3DPCASL is becoming option if scan time is the ease of use is an important time
	Com	 If reliability of absolute quantification is important, this protocol is recommended 	ease of use is an impo

3DPCASL and 2D PCASL CBF maps acquired from the same subject are shown below.

Also shown are corresponding anatomical images.



Parameters	2D				
Falameters	FAIR (QUIPPS II)	PCASL			
TR	2500 ms	4300 ms			
TE	3.2 ms	3.2 ms			
FOV	24 cm	24 cm			
# of Spirals	1 (single shot)	1 (single shot)			
Points per Spiral	4872	4872			
Image Matrix	64x64x20	64x64x24			
Slice Thickness	6 mm	6 mm			
Brain Coverage	12 cm	14.4 cm			
Temporal Bolus	800 ms	1800 ms			
Post Labeling Delay	1000 ms	1800 ms			
Background Suppression	Optional	Optional			
Scan Time	4:50 + 30-sec calibration	4:18 + 30-sec calib			

What are the standard scan and labeling parameters for each protocol?

Dual echo OptPCASL provides both BOLD and ASL time series simultaneously6,7,8.

If OptPCASL is used for a series of functional scans, the same scan can be used to acquire whole brain CBF in the same time it takes to use regular 2D PCASL but with improved labeling efficiency.

Please contact Conan Chen if you are interested in using the OptPCASL protocol for fMRI studies.

What other ASL techniques are out there?

We are actively involved in the development and testing of advanced ASL techniques. Some examples include velocity selective ASL9 and vascular territory imaging 10.

If you are interested in using these techniques for your study, please contact Conan Chen (coc004@ucsd.edu).

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Peripheral Equipment Usage

4.1 Peripheral Equipment Usage

4.1.1 Projectors

- In each control room there are two projectors the Lower projector and the Upper projector.
- The Lower projector is the main one used by many researchers. This uses the large projection screen that stands at the end of the table. This setup is helpful if your subject is claustrophobic.
- The Upper projector is used when you want to use the projection screen that goes inside the bore.
- Projector Power:
 - Both projectors can be turned on with the red button on the remote. Make sure you point the remote very close to the projector you want to use or you could accidently turn both of them on.
- To turn off the projector simply press the power button on the remote twice.
- Projector Source Selection:
 - If you are getting a no signal error message: Make sure the VGA cable is attached to your computer.
 Press the source bottom on the remote until VGA port A is selected then press the Enter button.
- Projector Resolution:
 - The native max resolution of the lower projector is 1280x800 and the upper projector is 1024x768.
 - Both can be set on your computer's "System Preferences" or "Control Panel" depending on which OS you are using. Please refer to your user manual.



width 1000



width 1000

4.1.2 Button Boxes

- The button box system at CFMRI contains the following components:
 - Electronic Interface
 - Fiber Optic cable
- Response Pads (2 button and 4 buttons)
 - 2 and 4 button handhelds
- SET UP
 - To test the optical part of the system without a computer: -The LEDs on the side of the interface box will light when the correesponding buttons is pressed. This means that the optical part of the system is working properly.
 - * Set the program switch for your specific application and handheld.
 - * The program switch is on the front plate of the interface box (see picture below). The switch has a small arrow which points to a number as shown below. Use a small flat headed screw driver to turn the switch to other positions.

Safety

5.1 Training

5.1.1 Safety Training

How do I sign up for Safety Training?

- Fill out the online registration form before the safety lecture. This information is needed to process your safety training. (link). NOTE: If you do not attend the next safety lecture you will have to register again.
- The Center schedules the Safety Training Lecture when 12 or more requests are received. The scheduled session will then be posted on the CFMRI website and notification will be distributed via CFMRI E-Updates. Please note that no individual notification will be issued..
- If you attend the safety lecture without registering, you will only be admitted if there is space. You will still need to complete the online registration forms before your training can be processed.
- After each Safety Lecture, the Webmaster will take the attendance record with the information submitted during registration and send out passwords to take the online test.
- Using the assigned password, take the online safety test. (Link: https://cfmriweb.ucsd.edu/etraining).
- We encourage everyone to attend the safety lecture even if they do not need the official training.
- You can verify your status at (https://cfmriweb.ucsd.edu/cfmri-training/check.php) the following day after you
 have completed the online safety test.

5.1.2 Operator Training

How do I sign up for Hands-on Operator training?

- You must have attended safety training and have passed the online safety test.
- Have your Project PI submit an on-line request (link: https://cfmriweb.ucsd.edu/operator-training). CFMRI Staff will schedule the training and contact you with dates and times.

- Complete the two 2-hours sessions. (Certificate will be awarded.)
- PI must email CFMRI (cfmri@ucsd.edu) requesting that the operator be added to their approved research project(s).
- Operators should submit the CFMRI Access Request Form (Online application) once they have been signed off by CFMRI Staff.

Training

6.1 Safety

6.1.1 Emergency Power Shutoff

When should I use the electrical power emergency shutdown button?

• Use the emergency power shutdown button when there is a fire in or near the MRI rooms, or if there is damage to the scanner that can be prevented by shutting down the electrical power (Note: shutting down the electrical power does not remove the magnetic field).

How do I shut off the electrical power to the scanner in case of an emergency?

- You can shut down the power by pushing the red triangle button on the keyboard or on the front of the magnet next to the bore entry.
- Or you can push the red buttons behind the plasic cover on the wall inside the control room (next to the control room door) or inside the manget room (right next to the control room door). These buttons will shut down the main transformer and cut off electrical power to the entire MRI system.

What do I do after I use the emergency power shutoff?

• Please do not attempt to turn the power back on by yourself. Instead, report your use of the emergency power system to CFMRI technical staff.

6.1.2 Quenching the Scanner

What should you do if the magnet quenches?

- Do not panic.
- Prop open the door between the operator room and the hallway.
- Prop open the door to the magnet room.
- Instruct any person in the magnet room to leave immediately and help them if it is safe to do so.

- Evacuate all personnel from the area until the air is restored to normal.
- When should you use the quench button? *The quench button is to be used only in the case of an emergency in which a person is injured and the only safe way to avoid further injury is to decrease the magnetic field strength of the magnet.

What happens when the quench button is pushed?

• Pushing the quench button will cause the liquid helium that cools the magnet to rapidly boil off. The quench pipe above the magnet is designed to allow the helium vent outside of the building. If the quench pipe fails, there is a danger that the magnet room will be filled with helium and that the oxygen in the room will be displaced, which could cause injury or death for anybody in the magnet room or the console room during a quench.

Why is the quench button only used in case of emergency?

• Quenching the magnet can be dangerous due to the rapid boil off of helium which creates dangerously high pressures and could displace oxygen from the room. A quench could cause permanent, irreparable damage to the magnet. If the magnet survives the quench it will have to be recharged which is very costly and time consuming.

Where is the quench button?

• The quench button is on the quench box which is mounted on the side wall inside each magnet room. Lift the spring loaded plastic cover to access the button.

6.1.3 Gauss Lines

The 5, 10 and 200 Gauss lines are marked on the floor of each magnet room. These Gauss lines serve as a reminder that you are inside a magnetic field which increases sharply as you move closer to the magnet. The 5 Gauss line (the outermost line) defines the limit beyond which ferromagnetic objects are strictly prohibited.

6.1.4 Fire Extinguisher

Where Can I Find a Magnet Safe Fire Extinguisher?

• There is a magnet safe fire extinguisher inside each magnet room next to the door. This fire extinguisher is blue and white. Please note, that the red fire extinguishers should not be taken into the magnet room at any time. Red fire extinguishers are ferromagnetic and present a serious hazard in the magnet room.

6.1.5 Safety Documentation

Safety Manual for Using the Scanner Supplementary Safety Guidelines 3.0 T MRI Initial Subject Recruitment/Advance Screening Form 3.0 T MRI Pre-procedure Screening Form 3.0 T MRI Operator's Check List

6.2 Additional Info

6.2.1 License

This is a generic license created by Aaron Jacobson.

6.2.2 Contact

Address:

UCSD Center for Functional MRI W.M. Keck Bldg 9500 Gilman Drive La Jolla, CA 92093-0677

Phone:

858-822-0513

Fax:

858-822-0605

E-Mail:

cfmri@ucsd.edu

Directions

- Exit Interstate 5 at La Jolla Village Drive-West
- Follow sign for Gilman Drive-North
- Turn right on Osler Lane

6.2.3 Need Assistance?

For assistance with protocol usage please contact Aaron Jacobson: ajacobson@ucsd.edu

Need further help

Contact us at cfmri@ucsd.edu

Indices and tables

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