



# CLUST

Challenge on Liver UltraSound Tracking

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## Datasets Info

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Table 1: Summary of the **2D** challenge data. The sequence name (first column) of the TestSet is listed in **black** font. The training sequences, for which all available annotations are provided, are highlighted in **red**.

Sequence	Sequence info				Annotation		Acquisition info		
	Im.size [pix/vox]	Im.res. [mm]	No. frames	Im.rate [Hz]	No. ann.	No.ann.-frames	Scanner	Probe	Center freq.[MHz]
CIL-01	480x640	0.30	1342	22	2	144	Ultrasoundix MDP	4DC7-3/40	4.5
CIL-02	480x640	0.40	1075	17	1	131	Ultrasoundix MDP	4DC7-3/40	4.5
CIL-03	480x640	0.40	1070	18	2	138	Ultrasoundix MDP	4DC7-3/40	4.5
CIL-04	480x640	0.50	895	15	2	112	Ultrasoundix MDP	4DC7-3/40	4.5
CIL-05	480x640	0.30	1430	23	2	161	Ultrasoundix MDP	4DC7-3/40	4.5
ETH-01-1[1, 2]	490x570	0.40	3652	15	2	366	Siemens Antares	CH4-1	2.22
ETH-01-2	482x608	0.41	4650	15	2	466	Siemens Antares	CH4-1	2.22
ETH-02-1	472x565	0.42	2620	15	1	263	Siemens Antares	CH4-1	2.22
ETH-02-2	462x590	0.41	4826	15	1	483	Siemens Antares	CH4-1	2.22
ETH-03-1	473x437	0.28	4588	14	1	460	Siemens Antares	CH4-1	2.22
ETH-03-2	464x442	0.28	4191	13	1	420	Siemens Antares	CH4-1	2.22
ETH-04-1	469x523	0.40	5247	16	2	525	Siemens Antares	CH4-1	1.82
ETH-04-2	480x652	0.38	4510	14	2	452	Siemens Antares	CH4-1	1.82
ETH-05-1	462x563	0.42	4615	15	2	463	Siemens Antares	CH4-1	1.82
ETH-05-2	477x556	0.40	3829	13	2	384	Siemens Antares	CH4-1	1.82
ETH-06-1	462x580	0.40	5244	16	1	525	Siemens Antares	CH4-1	2.00
ETH-06-2	476x604	0.38	5165	16	1	518	Siemens Antares	CH4-1	2.00
ETH-07-1	475x548	0.37	5586	17	2	560	Siemens Antares	CH4-1	1.82
ETH-07-2	467x568	0.37	5582	17	2	559	Siemens Antares	CH4-1	1.82
ETH-08-1	466x562	0.36	5574	17	2	558	Siemens Antares	CH4-1	1.82
ETH-08-2	466x589	0.36	5577	17	2	559	Siemens Antares	CH4-1	1.82
ETH-09-1	464x560	0.40	4587	15	4	460	Siemens Antares	CH4-1	1.82
ETH-09-2	479x566	0.42	4590	15	3	460	Siemens Antares	CH4-1	1.82
ETH-10-1	462x589	0.36	5578	17	3	559	Siemens Antares	CH4-1	1.82
ETH-10-2	470x595	0.36	5584	17	3	559	Siemens Antares	CH4-1	1.82
ETH-11-1	478x552	0.45	4284	14	2	429	Siemens Antares	CH4-1	2.22
ETH-11-2	476x541	0.45	3785	12.4	1	380	Siemens Antares	CH4-1	2.22
ETH-12-1	264x313	0.71	14516	25	1	1453	Siemens Antares	CH4-1	2.22
ETH-12-2	262x313	0.77	15640	25	1	1565	Siemens Antares	CH4-1	2.22
ETH-13-1	268x304	0.71	9934	25	1	994	Siemens Antares	CH4-1	2.00
ETH-13-2	268x304	0.71	10525	25	1	1054	Siemens Antares	CH4-1	2.00
ICR-01	393x457	0.55x0.42	4858	23	3	608	Elekta Clarity - Ultrasoundix	m4DC7-3/40	4.5
ICR-02	393x457	0.55x0.42	3481	23	2	436	Elekta Clarity - Ultrasoundix	m4DC7-3/40	4.5
ICR-03	393x457	0.55x0.42	3481	23	3	436	Elekta Clarity - Ultrasoundix	m4DC7-3/40	4.5
ICR-04	393x457	0.55x0.42	3481	23	4	349	Elekta Clarity - Ultrasoundix	m4DC7-3/40	4.5
ICR-05	397x485	0.55x0.43	3481	20	2	348	Elekta Clarity - Ultrasoundix	m4DC7-3/40	4.5
ICR-06	397x485	0.55x0.43	3481	21	2	348	Elekta Clarity - Ultrasoundix	m4DC7-3/40	4.5
ICR-07	397x495	0.49x0.33	3481	23	2	348	Elekta Clarity - Ultrasoundix	m4DC7-3/40	4.5
ICR-08	399x495	0.50x0.39	3481	23	3	348	Elekta Clarity - Ultrasoundix	m4DC7-3/40	4.5
ICR-09	399x485	0.57x0.44	3481	19.9	2	349	Elekta Clarity - Ultrasoundix	m4DC7-3/40	4.5
ICR-10	397x495	0.49x0.38	3481	23.5	2	349	Elekta Clarity - Ultrasoundix	m4DC7-3/40	4.5
MED-01-1	408x512	0.41	2455	20	3	246	DiPhAs Fraunhofer	VermonCLA	5.5
MED-02-1	408x512	0.41	2458	20	3	246	DiPhAs Fraunhofer	VermonCLA	5.5
MED-02-2	408x512	0.41	2443	20	3	245	DiPhAs Fraunhofer	VermonCLA	5.5
MED-02-3	408x512	0.41	2436	20	5	244	DiPhAs Fraunhofer	VermonCLA	5.5
MED-03-1	408x512	0.41	2442	20	2	245	DiPhAs Fraunhofer	VermonCLA	5.5
MED-03-2	408x512	0.41	2450	20	3	246	DiPhAs Fraunhofer	VermonCLA	5.5
MED-04-1	524x591	0.35	3304	11	1	331	Zonare z.one	C4-1	4.0
MED-05-1	524x591	0.35	3304	11	2	331	Zonare z.one	C4-1	4.0
MED-06-1	408x512	0.41	2427	20	4	243	DiPhAs Fraunhofer	VermonCLA	5.5
MED-06-2	408x512	0.41	2424	20	3	243	DiPhAs Fraunhofer	VermonCLA	5.5
MED-07-1	408x512	0.41	2470	20	3	248	DiPhAs Fraunhofer	VermonCLA	5.5
MED-07-2	408x512	0.41	2478	20	3	248	DiPhAs Fraunhofer	VermonCLA	5.5
MED-07-3	408x512	0.41	2450	20	3	246	DiPhAs Fraunhofer	VermonCLA	5.5
MED-07-4	408x512	0.41	2456	20	4	246	DiPhAs Fraunhofer	VermonCLA	5.5
MED-08-1	524x591	0.35	3304	11	3	331	Zonare z.one	C4-1	4.0
MED-08-2	524x591	0.35	3304	11	3	331	Zonare z.one	C4-1	4.0
MED-09	408x512	0.48	2420	30	1	243	DiPhAs Fraunhofer	VermonCLA 3.5	3.4
MED-10	408x512	0.45	2416	31	2	243	DiPhAs Fraunhofer	VermonCLA 3.5	3.4
MED-11	408x512	0.45	2425	31	2	243	DiPhAs Fraunhofer	VermonCLA 3.5	3.4
MED-12	408x512	0.48	2415	30	2	242	DiPhAs Fraunhofer	VermonCLA 3.5	3.4
MED-13	475x687	0.27	3135	17	1	314	Zonare z.one	C6-2	
MED-14	475x687	0.27	3855	17	2	386	Zonare z.one	C6-2	

Table 3: Summary of the **3D** challenge data. The sequence name (first column) of the TestSet is listed in **black** font. The training sequences, for which all available annotations are provided, are highlighted in **red**.

Sequence	Sequence info				Annotation		Acquisition info		
	Im.size [pix/vox]	Im.res. [mm]	No. frames	Im.rate [Hz]	No. ann.	No.ann. frames	Scanner	Probe	Center freq.[MHz]
<b>EMC-01</b> [6]	192x246x117	1.14x0.59x1.19	79	6	1	8	Philips iU22	X6-1	3.2
<b>EMC-02</b>	192x246x117	1.14x0.59x1.19	54	6	4	6	Philips iU22	X6-1	3.2
<b>EMC-03</b>	192x246x117	1.14x0.59x1.19	159	6	1	16	Philips iU22	X6-1	3.2
EMC-04	192x246x117	1.14x0.59x1.19	140	6	1	15	Philips iU22	X6-1	3.2
EMC-05	192x246x117	1.14x0.59x1.19	147	6	1	15	Philips iU22	X6-1	3.2
EMC-06-1	192x246x117	1.14x0.59x1.19	100	6	1	11	Philips iU22	X6-1	3.2
EMC-06-2	192x246x117	1.14x0.59x1.19	100	6	1	11	Philips iU22	X6-1	3.2
EMC-06-3	192x246x117	1.14x0.59x1.19	100	6	1	11	Philips iU22	X6-1	3.2
EMC-07-1	192x246x117	1.14x0.59x1.19	100	6	1	11	Philips iU22	X6-1	3.2
EMC-07-2	192x246x117	1.14x0.59x1.19	100	6	1	11	Philips iU22	X6-1	3.2
EMC-07-3	192x246x117	1.14x0.59x1.19	100	6	1	11	Philips iU22	X6-1	3.2
<b>ICR-01</b> [4, 3]	480x120x120	0.31x0.51x0.67	141	24	1	15	Siemens SC2000	4Z1c	2.8
ICR-02	480x120x120	0.31x0.51x0.67	141	24	1	20	Siemens SC2000	4Z1c	2.8
<b>SMT-01</b> [5]	227x227x229	0.70	97	8	3	96	GE E9	4V-D	2.5
<b>SMT-02</b>	227x227x229	0.70	96	8	3	92-93	GE E9	4V-D	2.5
<b>SMT-03</b>	227x227x229	0.70	96	8	2	45-96	GE E9	4V-D	2.5
<b>SMT-04</b>	227x227x229	0.70	97	8	1	96	GE E9	4V-D	2.5
SMT-05	227x227x229	0.70	96	8	2	64-96	GE E9	4V-D	2.5
SMT-06	227x227x229	0.70	97	8	3	49-96	GE E9	4V-D	2.5
SMT-07	227x227x229	0.70	97	8	2	95	GE E9	4V-D	2.5
SMT-08	227x227x229	0.70	97	8	3	96	GE E9	4V-D	2.5
SMT-09	227x227x229	0.70	97	8	3	96	GE E9	4V-D	2.5

## Data Structure

We divided the data into 2D and 3D ultrasound sequences. For each group, Training- and TestSets are provided. The TrainingSet directory contains images and ground truth labeling, while the TestSet directory contains images and the ground truth labeling of the first image.

Individual sequences are named as listed in Tables 1 and 3, and can be downloaded as .zip archives from the aforementioned directories. Each archive is divided into two directories, namely Data and Annotation. The Data directory contains the actual sequence of images. The Annotation directory contains the available annotations for the sequences.

## Ground Truth

Annotations are provided in the form t x y z, where t is the image number, and x y (z) are the pixel (voxel) coordinates of the annotated point.

The Annotation directory also contains .png images which illustrate the ground truth overlay for the initial frame, in order to allow participants to double check the right interpretation of the data.

## References

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- [2] Preiswerk, F., De Luca, V., Arnold, P., Celicanin, Z., Petrusca, L., Tanner, C., Bieri, O., Salomir, P., Cattin, P.C.: Model-guided respiratory organ motion prediction of the liver from 2D ultrasound. *Medical Image Analysis*, 18(5), 740–751 (2014).
- [3] Lediju, M.A., Byram, B.C., Harris, E.J., Evans, P.M., Bamber, J.C.: 3D Liver tracking using a matrix array: Implications for ultrasonic guidance of IMRT. In: IEEE Ultrasonics Symposium - IUS 2010. pp. 1628–1631 (Oct 2010)
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- [5] Vijayan, S., Klein, S., Hofstad, E., Lindseth, F., Ystgaard, B., Lango, T.: Validation of a non-rigid registration method for motion compensation in 4D ultrasound of the liver. In: IEEE 10th International Symposium on Biomedical Imaging - ISBI 2013. pp. 792–795 (April 2013)

- [6] Banerjee, J., Klink, C., Peters, E.D., Niessen, W.J., Moelker, A., van Walsum, T.: 4D Liver Ultrasound Registration. In: Biomedical Image Registration, Lecture Notes in Computer Science, vol. 8545, pp 194–202 (2014).