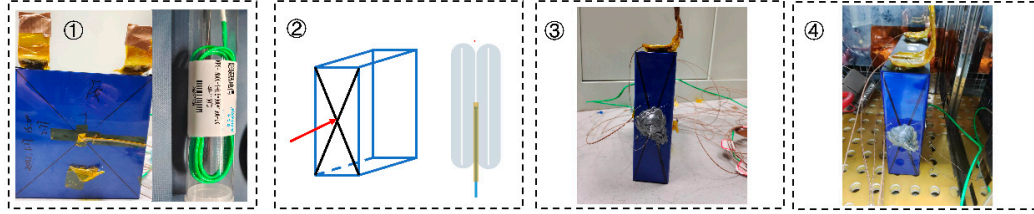
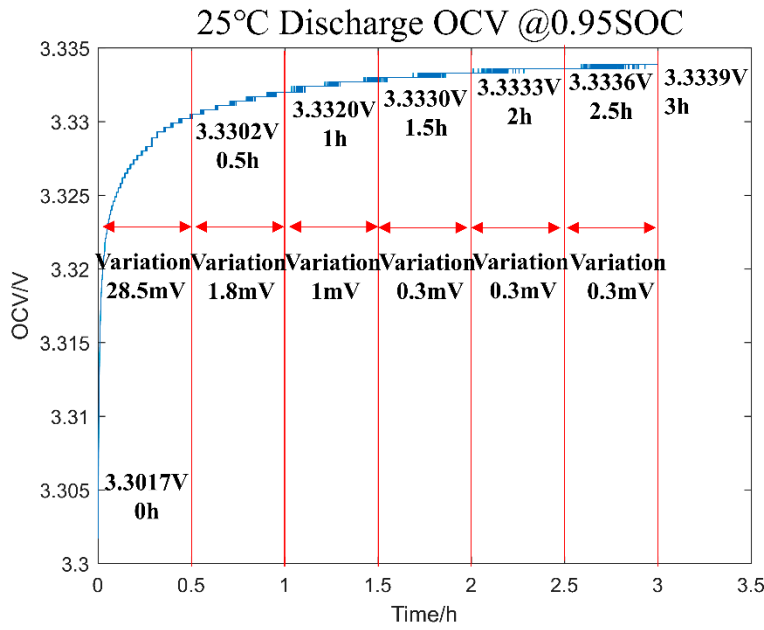


**The document is the supplementary material for the manuscript titled "Accurate Remaining Available Energy Estimation of LiFePO4 Battery in Dynamic Frequency Regulation for EVs with Thermal-Electric-Hysteresis Model."**

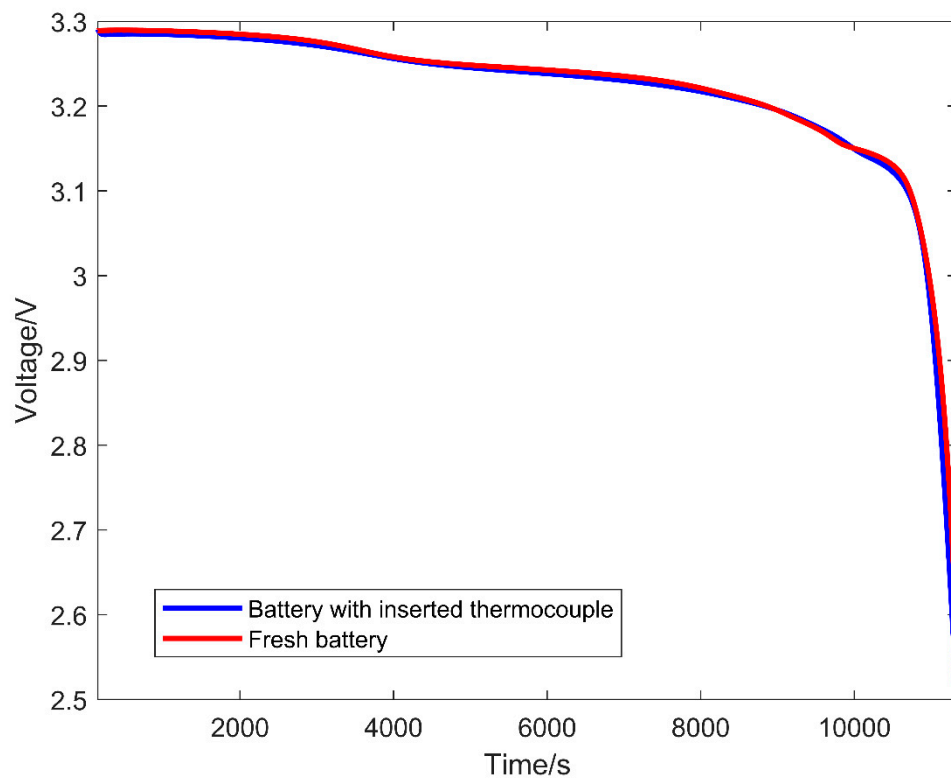


- Step 1. Discharge charge to 0 SOC, prepare K thermocouple and other materials.
- Step 2. Drill a hole in the side of the battery and insert a thermocouple insulated with polyimide tape.
- Step 3. Refill the electrolyte and seal with a solidified glue.
- Step 4. Set it aside for 24 hours to prepare for follow-up tests.

**Figure S1.** The detailed operating procedures of inserting thermocouple into the battery.



**Figure S2.** The variation of OCV over time.



**Figure S3.** 1/3C discharge voltage curve.

Table S1 to Table S2 present the results of the identification of equivalent circuit model parameters.

**Table S1. C1 parameter identification results @ 25°C unit: F**

SOC	1/3C	1/2C	1C
1	128.02	88.49	86.22
0.95	114.86	81.38	67.53
0.9	87.70	74.44	64.50
0.85	92.33	74.41	63.82
0.8	100.16	78.20	64.49
0.75	96.61	101.82	67.17
0.7	94.21	99.15	67.61
0.65	94.25	99.68	68.74
0.6	86.65	69.97	62.18
0.55	76.21	66.60	61.02
0.5	77.29	66.91	61.04
0.45	86.87	69.34	61.90
0.4	92.59	72.74	63.65
0.35	91.32	70.77	62.52
0.3	89.17	74.69	62.71
0.25	86.62	93.68	62.45
0.2	84.28	90.88	64.35
0.15	82.01	88.12	72.50
0.1	78.40	84.18	52.41
0.05	38.60	43.79	51.61
0	142.85	142.85	125

**Table S2. C1 parameter identification results @ 35°C unit: F**

SOC	1/3C	1/2C	1C
1	142.85	98.19	108.18
0.95	84.18	71.14	81.46
0.9	74.17	67.61	77.31
0.85	72.18	65.47	74.68
0.8	71.66	64.40	72.32
0.75	72.75	64.35	70.16
0.7	70.76	62.73	69.17
0.65	80.74	68.85	71.33
0.6	70.34	64.13	74.22
0.55	68.70	63.10	73.41
0.5	67.93	62.35	72.69
0.45	68.73	62.51	72.51
0.4	70.48	63.37	72.85
0.35	68.92	62.45	73.25
0.3	69.51	62.43	70.71
0.25	70.48	62.61	72.73
0.2	73.43	63.86	69.71
0.15	93.10	73.18	67.73
0.1	62.09	55.80	60.94
0.05	40.01	47.499	57.87
0	142.85	111.11	100.00

**Table S3. C2 parameter identification results @ 25°C unit: F**

SOC	1/3C	1/2C	1C
1	181.99	203.96	375
0.95	80.12	115.04	270.18
0.9	89.25	112.04	244.38
0.85	80.04	103.03	216.25
0.8	70.11	92.22	188.40
0.75	67.63	71.30	162.02
0.7	65.95	69.51	154.32
0.65	65.98	69.77	159.83
0.6	75.83	99.89	224.42
0.55	82.23	103.12	230.59
0.5	79.09	99.78	219.94
0.45	70.30	93.79	204.70
0.4	64.79	87.66	190.45
0.35	63.97	87.66	194.29
0.3	62.40	80.66	182.10
0.25	60.63	65.53	169.50
0.2	59.00	63.61	153.68
0.15	57.41	61.68	125.00
0.1	54.88	58.92	165.86
0.05	81.00	84.78	141.91
0	161.52	183.94	308.57

**Table S4. C2 parameter identification results @ 35°C unit: F**

SOC	1/3C	1/2C	1C
1	242.92	311.35	300.00
0.95	158.23	288.68	246.58
0.9	189.15	280.28	234.04
0.85	175.44	256.91	230.10
0.8	161.81	233.20	234.87
0.75	146.21	206.31	251.43
0.7	145.01	205.48	253.30
0.65	127.73	174.81	284.84
0.6	168.81	242.84	224.98
0.55	174.96	255.37	216.99
0.5	169.95	246.62	217.97
0.45	161.15	230.93	223.78
0.4	151.66	213.79	237.44
0.35	157.07	224.11	225.60
0.3	144.86	201.85	229.58
0.25	134.40	184.22	244.35
0.2	123.23	166.83	252.81
0.15	94.95	126.87	275.07
0.1	128.29	178.22	179.21
0.05	135.03	195.71	201.26
0	222.92	275.64	300.00

**Table S5.  $R_{\text{dis}}$  parameter identification results @ 25°C unit: m $\Omega$** 

SOC	1/3C	1/2C	1C
1	0.51	0.50	0.50
0.95	0.52	0.52	0.51
0.9	0.53	0.52	0.52
0.85	0.53	0.53	0.52
0.8	0.54	0.54	0.53
0.75	0.55	0.54	0.54
0.7	0.55	0.55	0.54
0.65	0.56	0.55	0.55
0.6	0.56	0.55	0.55
0.55	0.56	0.56	0.55
0.5	0.57	0.56	0.55
0.45	0.57	0.57	0.56
0.4	0.58	0.57	0.57
0.35	0.59	0.58	0.57
0.3	0.60	0.59	0.58
0.25	0.61	0.60	0.59
0.2	0.62	0.61	0.61
0.15	0.63	0.63	0.62
0.1	0.64	0.64	0.64
0.05	0.67	0.67	0.67
0	0.81	0.76	0.70

**Table S6.  $R_{\text{dis}}$  parameter identification results @ 35°C unit: m $\Omega$** 

SOC	1/3C	1/2C	1C
1	0.40	0.40	0.40
0.95	0.41	0.40	0.40
0.9	0.41	0.41	0.41
0.85	0.41	0.41	0.41
0.8	0.42	0.42	0.42
0.75	0.42	0.42	0.42
0.7	0.43	0.43	0.42
0.65	0.43	0.43	0.42
0.6	0.43	0.43	0.42
0.55	0.43	0.43	0.42
0.5	0.43	0.43	0.43
0.45	0.43	0.43	0.43
0.4	0.44	0.44	0.43
0.35	0.44	0.44	0.44
0.3	0.45	0.45	0.44
0.25	0.45	0.45	0.45
0.2	0.46	0.46	0.46
0.15	0.47	0.47	0.46
0.1	0.47	0.47	0.47
0.05	0.49	0.49	0.49
0	0.59	0.55	0.51



**Table S7.  $R_{\text{char}}$  parameter identification results @ 25°C unit: m $\Omega$** 

SOC	1/3C	1/2C	1C
1	0.51	0.50	0.50
0.95	0.50	0.50	0.50
0.9	0.51	0.51	0.51
0.85	0.52	0.52	0.51
0.8	0.53	0.52	0.52
0.75	0.53	0.53	0.52
0.7	0.54	0.54	0.53
0.65	0.55	0.55	0.53
0.6	0.55	0.54	0.53
0.55	0.55	0.55	0.53
0.5	0.55	0.55	0.54
0.45	0.56	0.55	0.54
0.4	0.56	0.56	0.55
0.35	0.57	0.56	0.55
0.3	0.58	0.57	0.55
0.25	0.59	0.58	0.56
0.2	0.59	0.59	0.57
0.15	0.60	0.59	0.57
0.1	0.61	0.60	0.58
0.05	0.62	0.62	0.60
0	0.81	0.76	0.70

**Table S8.  $R_{\text{char}}$  parameter identification results @ 35°C unit: m $\Omega$** 

SOC	1/3C	1/2C	1C
1	0.40	0.40	0.40
0.95	0.39	0.39	0.39
0.9	0.40	0.40	0.39
0.85	0.40	0.40	0.40
0.8	0.40	0.40	0.40
0.75	0.41	0.41	0.40
0.7	0.41	0.41	0.41
0.65	0.41	0.41	0.41
0.6	0.41	0.41	0.41
0.55	0.41	0.41	0.41
0.5	0.41	0.41	0.41
0.45	0.42	0.42	0.41
0.4	0.42	0.42	0.41
0.35	0.42	0.42	0.42
0.3	0.43	0.43	0.42
0.25	0.43	0.43	0.44
0.2	0.44	0.44	0.43
0.15	0.44	0.44	0.43
0.1	0.44	0.44	0.45
0.05	0.47	0.46	0.45
0	0.59	0.55	0.51

**Table S9.  $\tau_1$  parameter identification results @ 25°C unit: s**

SOC	1/3C	1/2C	1C
1	44.80	30.97	34.49
0.95	40.20	28.48	27.01
0.9	30.69	26.05	25.80
0.85	32.31	26.04	25.53
0.8	35.05	27.37	25.79
0.75	33.81	35.64	26.87
0.7	32.97	34.70	27.04
0.65	32.99	34.88	27.49
0.6	30.33	24.49	24.87
0.55	26.67	23.31	24.40
0.5	27.05	23.41	24.41
0.45	30.40	24.27	24.76
0.4	32.40	25.46	25.46
0.35	31.96	24.77	25.00
0.3	31.21	26.14	25.08
0.25	30.31	32.78	24.98
0.2	29.50	31.80	25.74
0.15	28.70	30.84	29.00
0.1	27.44	29.46	20.96
0.05	13.51	15.32	20.64
0	50.00	50.00	50.00

**Table S10.  $\tau_1$  parameter identification results @ 35°C unit: s**

SOC	1/3C	1/2C	1C
1	50.00	44.18	50.00
0.95	29.46	32.01	21.11
0.9	25.96	30.42	20.70
0.85	25.26	29.46	21.29
0.8	25.08	28.98	22.90
0.75	25.46	28.95	25.71
0.7	24.76	28.23	25.87
0.65	28.26	30.98	28.32
0.6	24.62	28.86	20.85
0.55	24.04	28.39	19.57
0.5	23.77	28.06	20.06
0.45	24.05	28.12	21.55
0.4	24.66	28.51	23.88
0.35	24.12	28.10	22.09
0.3	24.32	28.09	23.35
0.25	24.66	28.17	26.54
0.2	25.70	28.74	27.86
0.15	32.58	32.93	33.86
0.1	21.73	25.11	16.29
0.05	9.21	16.64	18.79
0	50.00	50.00	50.00

**Table S11.  $\tau_2$  parameter identification results @ 25°C unit: s**

SOC	1/3C	1/2C	1C
1	90.99	101.98	150.00
0.95	40.06	57.52	108.07
0.9	44.62	56.02	97.75
0.85	40.02	51.51	86.50
0.8	35.05	46.11	75.36
0.75	33.81	35.65	64.80
0.7	32.97	34.75	61.72
0.65	32.99	34.88	63.93
0.6	37.91	49.94	89.76
0.55	41.11	51.56	92.23
0.5	39.54	49.89	87.97
0.45	35.15	46.89	81.88
0.4	32.39	43.83	76.18
0.35	31.98	43.83	77.71
0.3	31.20	40.33	72.84
0.25	30.31	32.76	67.80
0.2	29.50	31.80	61.47
0.15	28.70	30.84	50.00
0.1	27.44	29.46	66.34
0.05	40.50	42.39	56.76
0	80.76	91.97	123.43

**Table S12.  $\tau_2$  parameter identification results @ 35°C unit: s**

SOC	1/3C	1/2C	1C
1	121.46	140.11	150.00
0.95	79.11	129.90	123.29
0.9	94.57	126.12	117.02
0.85	87.72	115.61	115.05
0.8	80.90	104.94	117.43
0.75	73.10	92.84	125.71
0.7	72.50	92.46	126.65
0.65	63.86	78.66	142.42
0.6	84.40	109.28	112.49
0.55	87.48	114.91	108.49
0.5	84.97	110.98	108.98
0.45	80.57	103.91	111.89
0.4	75.83	96.20	118.72
0.35	78.53	100.85	112.80
0.3	72.43	90.83	114.79
0.25	67.20	82.90	122.17
0.2	61.61	75.07	126.40
0.15	47.47	57.09	137.53
0.1	64.14	80.20	89.60
0.05	67.51	88.07	100.63
0	111.46	124.03	150.00