Early Detection of Human Epileptic Seizures Based on Intracortical Microelectrode Array Signals Supplementary Materials

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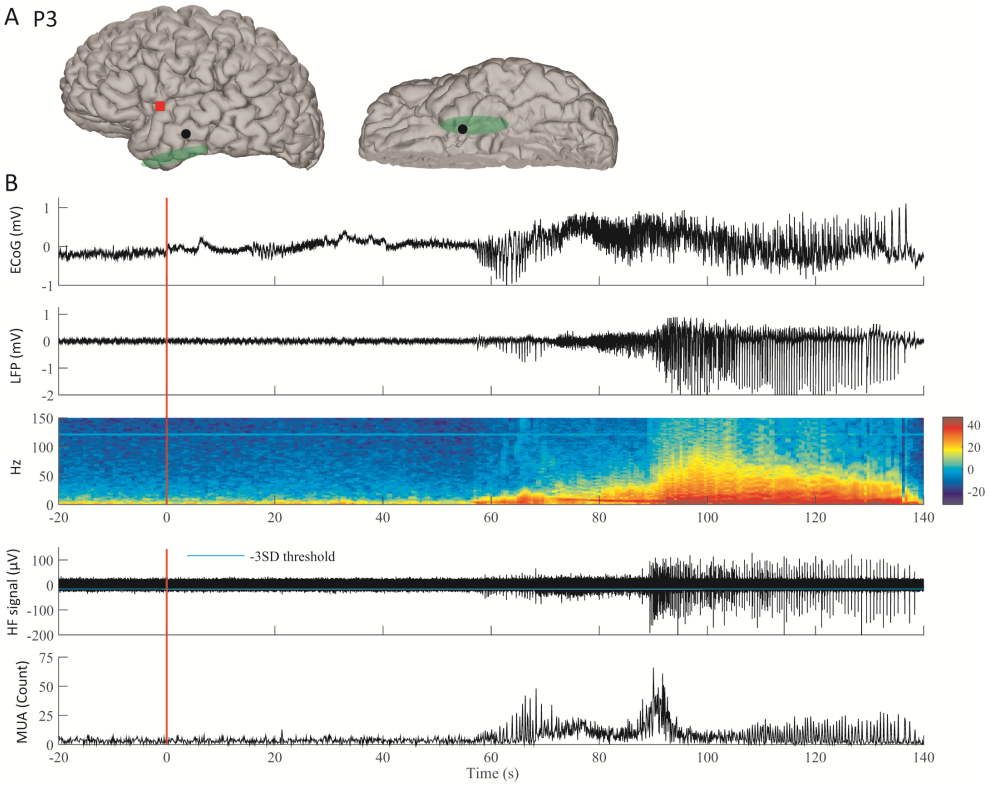
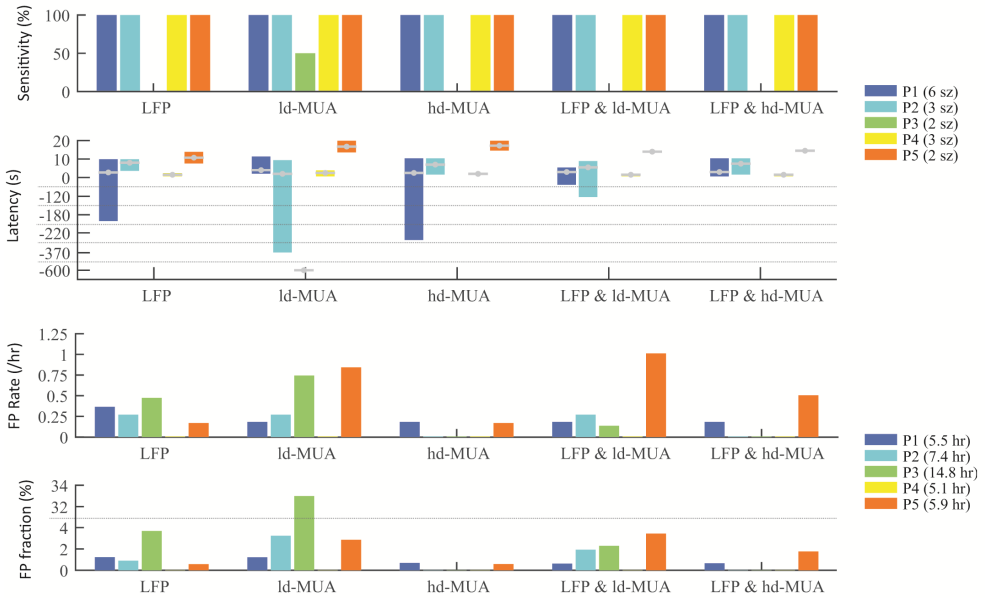
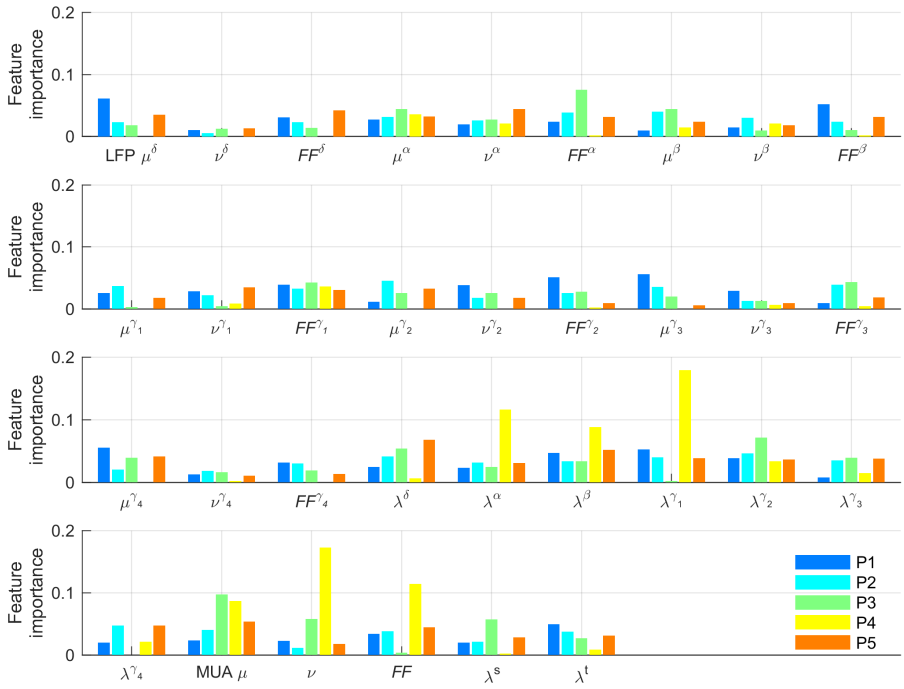


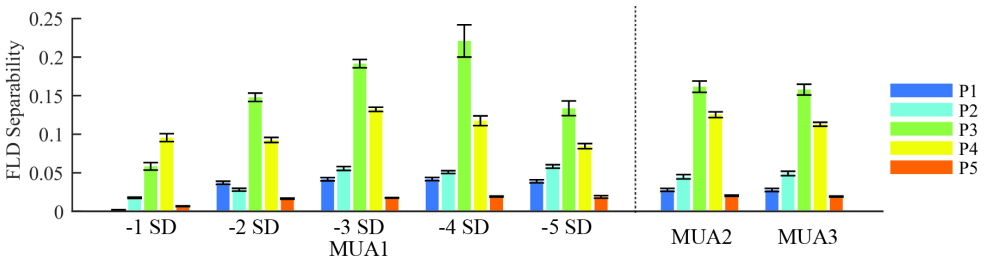
Supplementary Fig. 1. ECoG, LFP, and MUA traces in P3. (A) Same conventions as in Figure 1 (main text), except that the black dot represents the projection onto the brain surface of the location of a depth-electrode channel. (B) The two seizures in P3 started in a very local, confined way, being restricted to only one or two iEEG recording sites, before abruptly spreading through the other iEEG and MEA sites. The top ECoG trace shows one of the seizures. The three bottom plots show the corresponding neural signals recorded by the MEA; The seizure onset was detected in the MEA 58.01 s after being detected in one of the iEEG recording sites. The second seizure (not shown) was detected in the MEA 123.16 s after being detected in the iEEG recording sites.



Supplementary Fig. 2. Detection performance in individual participants for different signal/feature types. In contrast to the results reported in Figure 6 (main text), here the seizure onset times were determined based on iEEG, not MEA, recordings. Same conventions as in Figure 6 (main text). Except for P3, whose seizure remained very localized for tens of seconds, detection performance for all of the other participants was very similar to that reported in Figure 6.



Supplementary Fig. 3 Feature importance in individual participants according to XGBoost classifiers.



Supplementary Fig. 4. FLD separability based on different MUA definitions for individual participants. We used rebalancing and resampling [35] to estimate FLD means and standard deviations.

SUPPLEMENTARY TABLE 1 – SUMMARY OVER ALL PARTICIPANTS (EXCEPT P3)

DETECTION PERFORMANCE WITH RESPECT TO IEEG-DETERMINED SEIZURE ONSETS. SAME CONVENTIONS AS IN TABLE 1.

	Signal/Feature type				
	LFP	ld-MUA	hd-MUA	LFP + ld-MUA	LFP + hd-MUA
Sensitivity (%)	100 % (14/14)	100 % (14/14)	100 % (14/14)	100 % (14/14)	100 % (14/14)
Latency (s)	3.5, -8.1 [-183.0, 13.5]	3.8, -20.6 [-369.5, 19.5]	2.5, -10.1 [-223.5, 19.5]	3.0, -4.3 [-120.0, 14.0]	3.0, 5.4 [1.0, 14.5]
FP rate (/h)	0.21/h (5 (2)/23.9 h)	0.33/h (8 (0)/23.9 h)	0.08/h (2 (0)/23.9 h)	0.38/h (9 (1)/23.9 h)	0.17/h (4 (0)/23.9 h)
FP fraction (%)	0.70%	1.99%	0.30%	1.59%	0.59%

SUPPLEMENTARY TABLE 2 – PARTICIPANT P3

DETECTION PERFORMANCE WITH RESPECT TO IEEG-DETECTED SEIZURE ONSETS. SAME CONVENTIONS AS IN TABLE 1.

	Signal/Feature type				
	LFP	ld-MUA	hd-MUA	LFP + ld-MUA	LFP + hd-MUA
Sensitivity (%)	0 % (0/2)	50 % (1/2)	0 % (0/2)	0 % (0/2)	0 % (0/2)
Latency (s)	NA	-600	NA	NA	NA
FP rate (/h)	0.47/h (7 (0)/14.8 h)	0.74/h (11 (0)/14.8 h)	0.00/h (0 (0)/14.8 h)	0.14/h (2 (0)/14.8 h)	0.00/h (0 (0)/14.8 h)
FP fraction (%)	3.69%	32.98%	0.0%	2.30%	0.0%