# VIVOSense

## Actigraphy pilot study to compare baseline performance of canonical sleep algorithms

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#### MOTIVATION

- Sleep: a crucial role in overall health and quality of life  $\bullet$
- Wrist-worn actigraphy: a cost-effective and unobtrusive method
- There has not yet been a comprehensive comparison of published sleep algorithms



#### **FUTURE WORK & PLANS**

#### **DEVELOPING AND VALIDATING FUTURE SLEEP ALGORITHMS COLLABORATIVELY**

#### AADITUUJA TEA

od F ar model f	Features used Scaled activity count in 7- minute window	Output Sleep label of each epoch	Open source R package actigraph.sleepr	
r model	Scaled activity count in 7- minute window	Sleep label of each epoch	R package actigraph.sleepr	
r model f	Statistics of activity count			
	From an 11-epoch window	Sleep label of each epoch	R package actigraph.sleepr	
sion Tree	Activity counts over time	Sleep label of each epoch	R package PhysActBedRes	Moderat
en Markov el, Fisher's r discriminate	Median and s.d from epochs	Sleep label of each epoch	https://gitlab.eecs.umich.edu/yayazhai/ shezhai_bme2020	
mation S	Sleep label of each epoch	sleep quality metrics	R package actigraph.sleepr	Mil
A & RESU	JLTS			PHASE 01 (3-6 MONTHS)
	on Tree Markov Fisher's Jiscriminate	Activity counts over time Markov Fisher's Iscriminate Median and s.d from epochs Sleep label of each epoch	on TreeActivity counts over timeSleep label of each epochMarkov Fisher's discriminateMedian and s.d from epochsSleep label of each epochnationSleep label of each epochsleep quality metrics <b>&amp; RESULTS</b>	Image:





#### RESULTS

Table 1. Performance of sleep detection algorithms versus expert-curated reference sleep annotations.

	PRO	CK	S	CK+TL	S+TL	Т	SZ
Accuracy	0.96 0.87 0.90		0.90	0.95 0.93		0.95	0.72
Sensitivity	0.80	0.83 0.80		0.82	0.75	0.88	0.79
Specificity	0.85	0.85 0.82 0.88		0.94 <u>0.95</u>		0.90	0.59
F1 Score	0.95	0.95 0.83 0.86		0.92	0.88	0.92	0.68
Sleep onset <sup>a</sup>	1 ± 121	188 ± 136	189 ± 137	39 ± 80	62 ± 94	36 ± 69	-22 ± 191
Sleep duration <sup>a</sup>	<sup>a</sup> -12 ± 123 -373 ± 110 -401 ± 9		-401 ± 99	-75 ± 105 -119 ± 119		-60 ± 96	40 ± 250
Sleep offset <sup>a</sup>	-11 ± 33	-184 ± 125	-212 ± 123	-36 ± 70	-57 ± 87	-21 ± 64	18 ± 186

<sup>a</sup>.Mean ± s.d. (unit of minutes) of the difference between predicted and ground truth.

Figure 1. Agreement rate between algorithm predictions, participant reported sleep and truth.

#### CONCLUSION

- Cole-Kripke + Tudor Locke and Tracy sleep algorithms **EXCEL** at the epoch level.
- **NONE** of the algorithms provide a perfect estimate of sleep period.
- We're dedicated to enhancing these algorithms and generating more evidence to enhance the quality and reliability of data derived from meaningful patient-centered measures.

							<b>—</b>	L		1
	1.0	0.7	0.7	0.7	0.7	0.7	0.7	0.7	sz	
	0.7	1.0	0.9	0.9	0.8	0.9	0.9	0.8	ск	0.95
	0.7	0.9	1.0	0.9	0.9	0.9	0.9	0.9	s	0.85
	0.7	0.9	0.9	1.0	1.0	0.9	1.0	0.9	CK+TL	0.8
	0.7	0.8	0.9	1.0	1.0	0.9	0.9	0.9	S+TL	0.75
	0.7	0.9	0.9	0.9	0.9	1.0	0.9	0.9	т	0.7
l L	0.7	0.9	0.9	1.0	0.9	0.9	1.0	1.0	truth	
	0.7	0.8	0.9	0.9	0.9	0.9	1.0	1.0	PRO	
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			C	) -						

### **REFERENCES & ACKNOWLEDGMENTS**

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