
Learning to Assess Chronic Diseases: Early Diagnosis, Severity, Progression, and Medication Response

Yuzhe Yang

PhD Candidate, Department of EECS, MIT

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Abstract:

Chronic diseases, such as Alzheimer's and Parkinson's, pose significant challenges due to their delayed diagnoses, with symptoms becoming clinically evident after decades of progression, leading to irreversible damage. Moreover, current assessments rely on patient self-reports or subjective clinical evaluations, resulting in sporadic and noisy data that obscure our understanding of these diseases. Can we detect chronic diseases earlier, potentially before they manifest clinically? And can we objectively measure disease status on a daily basis to gain insights into its longitudinal trajectory and response to therapy? In this talk, I will present machine learning methods to bridge these gaps, using Parkinson's disease as a driving example. I will introduce an AI-driven biomarker that detects Parkinson's years before clinical diagnosis, using just nocturnal breathing signals. I will then discuss how we can achieve accurate estimation of disease severity, and consequently long-term tracking of disease progression through daily monitoring. Finally, I will highlight the potential of AI to realize passive and in-home monitoring of medication response, paving the way for personalized healthcare.

Reading list:

- AI-driven biomarkers for Parkinson's disease:
 - Early diagnosis and severity estimation: <https://www.nature.com/articles/s41591-022-01932-x.pdf>
 - Progression and medication response: <https://www.science.org/doi/epdf/10.1126/scitranslmed.adc9669>
- Underlying machine learning methods:
 - Addressing imbalanced regression: <https://arxiv.org/pdf/2102.09554.pdf>
 - Addressing multi-domain imbalance: <https://arxiv.org/pdf/2203.09513.pdf>