**Introduction**

Problem: Survival Analysis
- Accurate prediction of Disease Trajectories is critical for the Early Identification and Timely Treatment of patients at risk.

Current Methods
- Statistical methods like Cox Landmarking and Joint Modeling are often limited by parametric assumptions and computationally constrained.
- Recent Deep Learning approaches improve on these limitations, but do not capture potential information in longitudinal covariate histories.

Main Ideas
- Issue Dynamically Updated survival predictions via longitudinal sliding-window mechanism.
- Use Temporal Convolutions to capture explicit representations of temporal dependencies.
- Accommodate potentially informative patterns of Missingness with dual-stream structure.

**Problem Formulation**

Notation
- Covariate Vector \( x_{i,t} \) for Patient \( i \in \{1, ..., N\} \) at Time \( t \) where time has discrete resolution \( \delta \).
- Survival Datum \((t, x_{i,t}, s_{i,t})\), where \( s_{i,t} \) is the binary Survival Indicator for event of interest.
- Time-to-Event \( T_i = \min(T_{\text{cens}}, T_{\text{cens}})\), where \( T_{\text{cens}} \) is the random variable for time of Event Occurrence and \( T_{\text{cens}} \) for Right-Censoring.

Dynamic Prediction
- Historical Window of observations in \((t - w, t]\), where \( w \) indicates the width of lookback:
  \[
  X_{i,t-w} = \{(t', x_{i,t'}, s_{i,t'})\}_{t' \leq t}
  \]
- Failure Prediction for forward interval \((t, t + \tau]\), where \( \tau \) indicates the prediction horizon:
  \[
  F_i(t; t + \tau) = \mathbb{P}(T_{\text{cens}} \leq t + \tau | T_{\text{cens}} > t, x_{i,t,w})
  \]

**Related Work**

Non-Deep Direct-to-Time Dynamic Linearity Learning Probability Variance Prediction

1. \[x\] \[N\] \[N\] \[N\] \[x\] \[x\]
2. \[x\] \[N\] \[x\] \[x\] \[x\] \[x\]
3. \[x\] \[x\] \[x\] \[x\] \[x\] \[x\]
4. \[x\] \[x\] \[x\] \[x\] \[x\] \[x\]
5. \[x\] \[x\] \[x\] \[x\] \[x\] \[x\]
6. MATCH-Net


**Discriminative Performance**

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<th>( \tau )</th>
<th>MATCH-Net</th>
<th>S-TCN</th>
<th>S-MLP</th>
<th>FCN</th>
<th>D-Atlas</th>
<th>RNN</th>
<th>MLP</th>
<th>JM</th>
<th>LM</th>
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Performance for \( \tau_{\max} = 5.5, \delta = 2/3 \) years. *indicates statistically significant difference (p < 0.05) with MATCH-Net.

**Use Case: Personalized Screening**

MATCH-Net: Dynamic Prediction in Survival Analysis using Convolutional Neural Networks

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This work was supported by the Office of Naval Research and the National Science Foundation