You're Not Alone in Battle: Combat Threat Analysis Using Attention Networks and a New Open Benchmark

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Code and Data: https://github.com/syleeheal/SAFETY

Summary

- Benchmark Task and Dataset
  - We propose the first benchmark dataset of combat simulations.
  - We propose a benchmark task for realistic combat threat analysis (CTA).
- Model and Experiments
  - We propose a novel spatio-temporal attention network for CTA.
  - Our proposed model shows the best performance in CTA.

Introduction

- Combat Threat Analysis (CTA)
  - CTA analyzes combat to provide info. about imminent security threats.
- Characteristics of Combats

Concepts and Definitions

- Entity: refers to the smallest force unit within a combat (e.g., a soldier).
- Squad: refers to a set of few entities sharing the same intention.
- Combat: refers to a unit of battle over time.
- Attack: indicates whether or not an attack between a squad will occur during combat.
- Tactic: refers to the overarching strategy that a force share in combat.

Proposed Benchmark Task

- Problem Formulation for Combat Threat Analysis
  - Given: Combats with noisy or missing features.
  - Predict: Intention and attack for combats with unsupervised tactics.

Proposed Benchmark Dataset

- Dataset Overview
  - A synthetic dataset based on computer simulations of ground force combats.
  - It contains a total of 1238 combat simulations, each with one of four tactics.
  - Each entity has temporal features.
  - Each squad has intention labels, and a squad pair has attack labels.
  - TSNE shows that combats with each tactic have distinct feature distributions.

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Proposed Model

- SAFETY (Spatio-temporal Attention For Threat Analysis)
  - Composed of a spatio-temporal attention, squad aggregation, and a classifier.
  - Transformer-style self-attention is applied.
  - Predicts intention and attack probability.

Experimental Results

- Prediction for Unseen Tactics under Noise and Missing Features
  - Noise: We add noise to input features.
  - Mask: We randomly mask the input features to reflect missing features.
  - Unseen Tactic: Models are trained on 3 tactics and evaluated on 1 untrained tactic.
  - Metric: F1 for intention prediction; AUROC for attack prediction.
  - Results: SAFETY significantly outperforms the baseline methods in both intention and attack prediction by a large margin.

Conclusion

- Comprison to the Prior Works
  - Dataset: This is the first open-source benchmark dataset for CTA.
  - Task: We argue for the importance of predicting unseen tactics under feature noise.
  - Model: We demonstrate importance of interaction modeling for CTA.
- Future Directions
  - Dataset: More realistic combat dataset (e.g., introduce new squads over time).
  - Task: Our work did not predict time in which each attack occurs.
  - Model: A scalable model that considers massive interactions of real-world combats.