RingTool Replication

Reproduction of thuhci/RingTool Experiments

Fu Jingyu

June 24, 2025

GitHub: ElizabethLydia/RingTool

1. Introduction

- Fork of thuhci/RingTool for physiological signal prediction using wearable rings.
- Objective: Replicate experiments with physical (Peak, fft, Ratio) and supervised models (ResNet, Mamba2, Transformer).
- Dataset: Kaggle Ring Dataset (7 subjects, tasks: hr, resp_rr, spo2, BP).
- Validation: 5-fold cross-validation and test-mode experiments.
- Repository: github.com/ElizabethLydia/RingTool

2. Experiment Setup

Environment

- OS: Ubuntu 22.04 LTS
- Hardware: 4x NVIDIA RTX 3080 (16GB each, 64GB total), CUDA 11.8
- Python: 3.10.16 (Conda: `ringtool`)
- Dependencies: `torch==2.1.2`, `pandas==1.5.3`, `mamba_ssm==2.2.2`, `numpy==1.23.5`

Dataset and Validation

- Subjects: 00005, 00009, 00012, 00020, 00022, 00031
- Tasks: hr, resp_rr, spo2, BP_sys, BP_dia, samsung_hr, oura_hr

Physical Methods

Peak: HR, RR. fft: HR, RR. Ratio: SpO2.
Configs: `config/physical-based/`

Supervised Methods

Models: ResNet, InceptionTime, Mamba2, Transformer
Configs: 33 in `config/supervised/`

3. Scripts Overview (Config)

update_configs.ipynb

- **Function**: Validates 7 subjects' dataset (.pkl files), updates supervised models' 5-fold configs.
- **Code**:

```
# Define single split (for testing)
config["split"]["train"] = available_subjects[:5]  # ['00029', '00009',
'00005', '00022', '00020']
config["split"]["valid"] = available_subjects[5:6]  # ['00012']
config["split"]["test"] = available_subjects[6:]  # ['00031']

# Generate 5-fold splits
folds = {}
for i in range(5):
    random.shuffle(available_subjects)  # Randomize for each fold
    folds[f"Fold-{i+1}"] = {
        "train": available_subjects[:5],
        "valid": available_subjects[5:6],
        "test": available_subjects[6:]
    }
config["split"]["5-Fold"] = folds
```

3. Scripts Overview (Experiments)

run_experiments_with_resume.py

- **Function**: Executes experiments (physical/supervised), resumes checkpoints, outputs `all_results.csv`. Use `batch_size = 32` for memory errors.
- **Core code**:

```
config = load_config(config_path)
config["_config_path_"] = config_path
config["mode"] = "5fold"
```

run_experiments_test.py

- **Function**: Runs test-mode experiments.
- **Run**:

```
config = load_config(config_path)
config["_config_path_"] = config_path
config["mode"] = "test"
```

3. Scripts Overview (Analysis)

resultsCollection.ipynb

- **Function**: Merges results into ‘all_results.csv‘

```
csv_dir = "/root/RingTool/csv/"
output_file = "/root/RingTool/all_results.csv"
```

dataAnalysis.ipynb

- **Function**: Data Filtering, mata deduplication, merges `all_results.csv`, generates MAE barplots/heatmaps in `output/`. Requires `matplotlib==3.8.2`.

4. How to Run (Setup)

- **Setup Environment**:

```
conda create -n ringtool python=3.10.16
conda activate ringtool
pip install -r requirements.txt
```

- **Download Dataset**:
  - From Kaggle.
  - Unzip to `/root/RingTool/data/rings/`:

```
mkdir -p /root/RingTool/data/rings
mv path/to/ring-dataset/* /root/RingTool/data/rings/
```

4. How to Run (Experiments)

Update Configurations:

- Run `update_configs.ipynb` for 5-fold splits:

```
conda activate ringtool
jupyter notebook update_configs.ipynb
```

Physical Methods:

- Run:

```
cd /root/RingTool
conda activate ringtool
python3 main.py \
--data-path /root/RingTool/data/rings \
--batch-configs-dirs config/physical-based
```

4. How to Run (Experiments)

Supervised Methods:

- Run:

```
conda activate ringtool
python run_experiments_with_resume.py
```

Test-Mode Experiments:

- Run:

```
conda activate ringtool
python run_experiments_test.py
```

8. How to Run (Analysis)

Analyze Results:

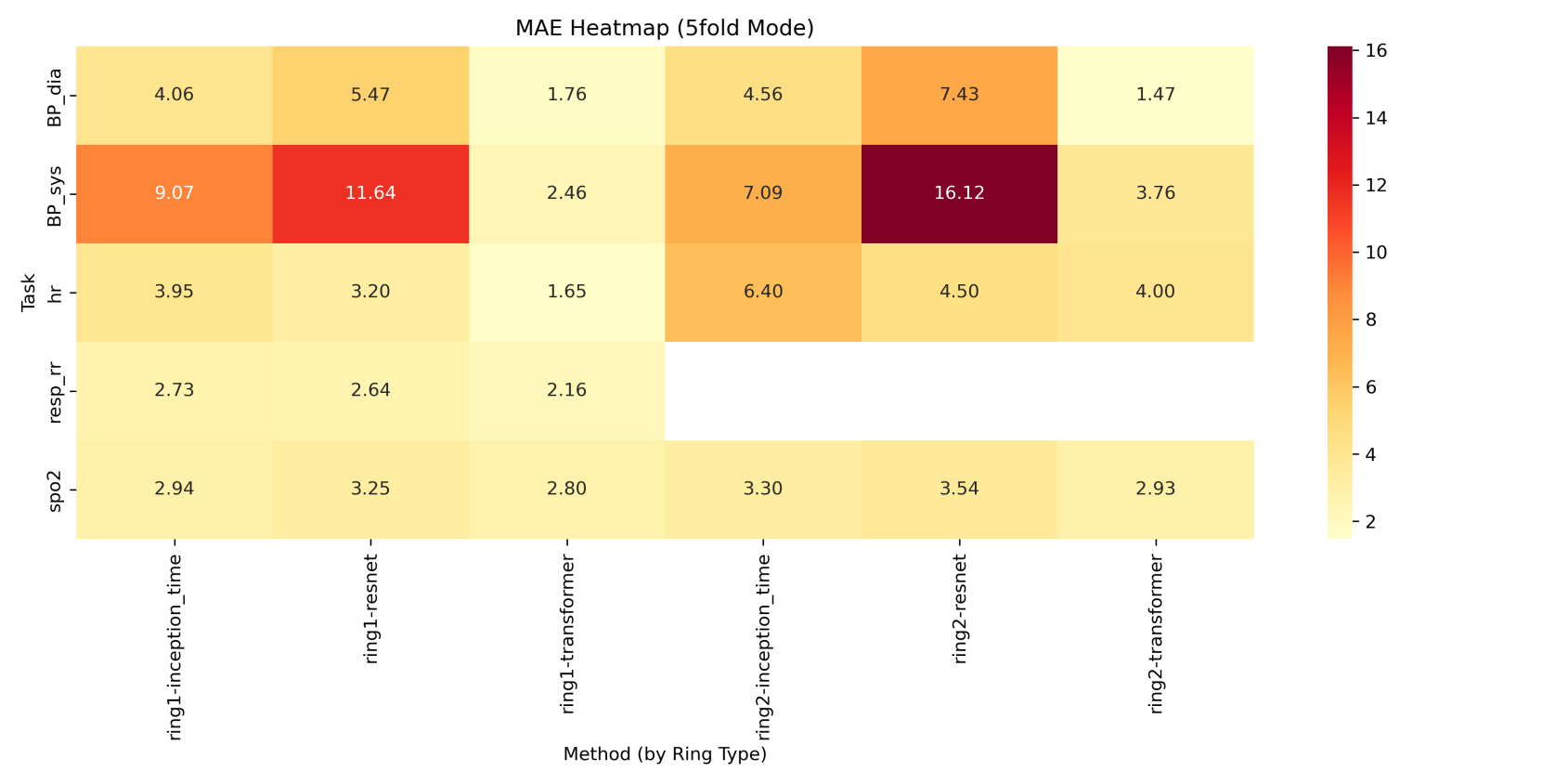
- Run notebooks to collect and analyze results:

```
conda activate ringtool
jupyter notebook resultsCollection.ipynb
jupyter notebook dataAnalysis.ipynb
```

5. Results

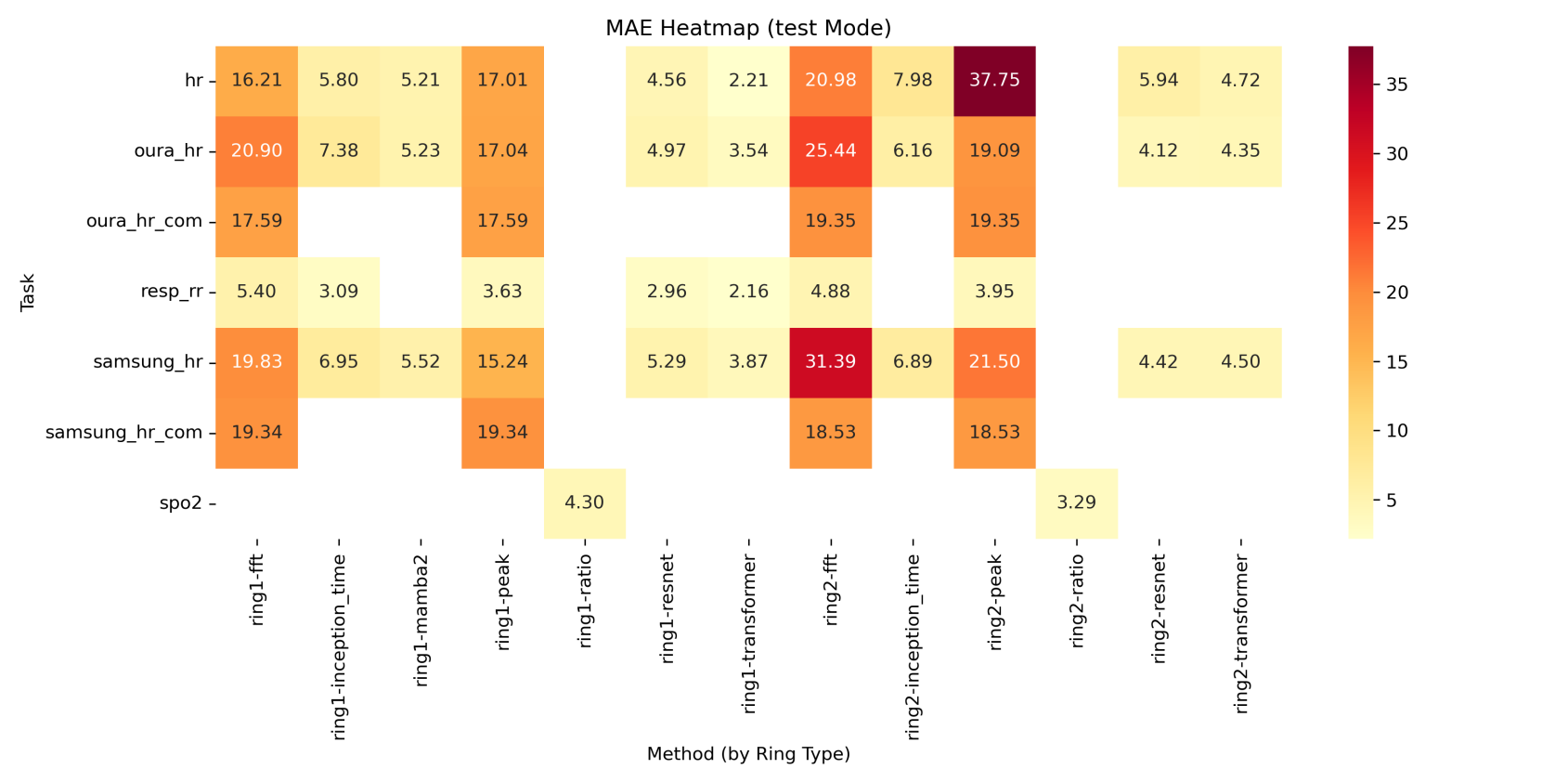
Task	Ring	Method	MAE	Task	Ring	Method	MAE
hr	ring1	Transformer	2.205	hr	ring2	Transformer	4.720
hr	ring1	Peak	17.010	hr	ring2	Peak	37.753
hr	ring1	fft	16.213	hr	ring2	fft	20.977
resp_rr	ring1	Transformer	2.162	resp_rr	ring2	Peak	3.953
resp_rr	ring1	Peak	3.630	resp_rr	ring2	fft	4.875
resp_rr	ring1	fft	5.400	-	-	-	-
spo2	ring1	Transformer	2.800	spo2	ring2	Transformer	2.930
spo2	ring1	Ratio	4.300	spo2	ring2	Ratio	3.290
BP_dia	ring1	Transformer	1.760	BP_dia	ring2	Transformer	1.470
BP_sys	ring1	Transformer	2.460	BP_sys	ring2	Transformer	3.760
oura_hr	ring1	Transformer	3.537	oura_hr	ring2	ResNet	4.117
oura_hr	ring1	Peak	17.040	oura_hr	ring2	Peak	19.093
oura_hr	ring1	fft	20.900	oura_hr	ring2	fft	25.360
samsung_hr	ring1	Transformer	3.867	samsung_hr	ring2	ResNet	4.423
samsung_hr	ring1	Peak	15.237	samsung_hr	ring2	Peak	21.497
samsung_hr	ring1	fft	19.830	samsung_hr	ring2	fft	31.387

6. Visualizations



figuremae_heatmap_5fold.png

6. Visualizations



figuremae_heatmap_test.png

7. Challenges and Resolutions

- **Shared Memory Error (Mamba2)**:
  - Issue: Triton error (required: 163840, limit: 101376).
  - Resolution: Reduced `batch_size` in `run_experiments_with_resume.py`.
- **Missing Subjects**:
  - Issue: Configs referenced unavailable subjects (e.g., 00017).
  - Resolution: Updated configs in `ringtool_replicate.ipynb` to use 7 available subjects.
- **Pandas Compatibility**:
  - Issue: `TypeError` with `pandas==2.2.3`.
  - Resolution: Downgraded to `pandas==1.5.3`.

8. Acknowledgments

- Thanks to thuhci/RingTool team at Tsinghua University.
- Dataset: Kaggle Ring Dataset.
- Conducted by Fu Jingyu, June 2025.
- Repository: github.com/ElizabethLydia/RingTool