Classifyng Objects at Differents Sizes with Multi-scale Stacked Sequential Learning

Eloi Puertas, Sergio Escalera and Oriol Pujol
Summary

1. Problem Motivation
2. Multi-Scale Stacked Sequential Learning
3. Learning at multiple scales
4. Experiments and results
5. Conclusions
Sequential learning

• Classification task.
• Non i.i.d. samples.
• Neighboring samples have some kind of relationship.
• Neighboring labels also have some kind of relationship.

Application: Object Classification
• Access to the full data sequence
• All labels have to be given at a time

1D SL- time/sequence relationship, 2D SL- spatial relationship.
Not to be confused with …

**Time series prediction**
Real labels up to time $t$ available, only need to predict label at time $t+1$.
Access to data up to time $t$.

**Sequence classification**
One label expected from a full sequence

“pagoda”

**Segmentation**
Associated with region division according to some homogeneity criterion
But when classifying objects, each pixel is an example, and quite often relationships between pixels are long-distance relationships inside an object.

Combination by increasing the input space with data of the neighboring labels

Multiscale Stacked Sequential Learning

• **MSSL**: Stacked Sequential Learning that can effectively identify and use long-distance relationships.

• Multiscale decomposition of $y'$ for each label using Gaussian Filters.

• Use of likelihoods instead of label value.
Multiscale Stacked Sequential Learning

Background/Flower

- Scale

+ Scale

- Multiscale decomposition of y' for each label using Gaussian Filters.
- Use of likelihoods instead of label value.
Classifyng Objects

- With MSSL we have learned relationships between pixels belonging to an object for a concrete training set.
Classifying Objects at different sizes

Problem:

– Relationships between pixels change if object size changes.
– It is not possible to learn at all possible sizes?
Learning at multiple scales

**Train:** templates -> training images at same scale.

**Test:** shift scales -> perform several testing phases shifting scales.

**Aggregation:** Maximum likelihood value for each pixel.
Experiments

Validation Experiment: horses

Training phase: Horse Images

Testing phase: Same horse images resized to its half size.

Train

Test

MSSL Result

Scales \{2,4,8\}

Scales \{1,2,4\}
Flowers classification

Training phase:
- Flower template. 16 images at same size.
- Only color features, no spatial features.
- Adaboost classifiers.
- Scales $= \sum\{18,27,41\}$.

Testing phase:
- Scales $= \sum\{0.5,3,5,8,12,18,27,41\}$.
- 6 testing rounds per image.

Aggregation:
- Take the maximum for all rounds.
Conclusions

- Multiscale Stacked Sequential Learning is a useful framework for object classification task.
- Results are comparable with those of the state-of-the-art methodologies like CRF.
- Without retraining we can classify correctly images at different scales, only performing some extra test rounds.