Comparison of Two Approaches for Direct Food Calorie Estimation

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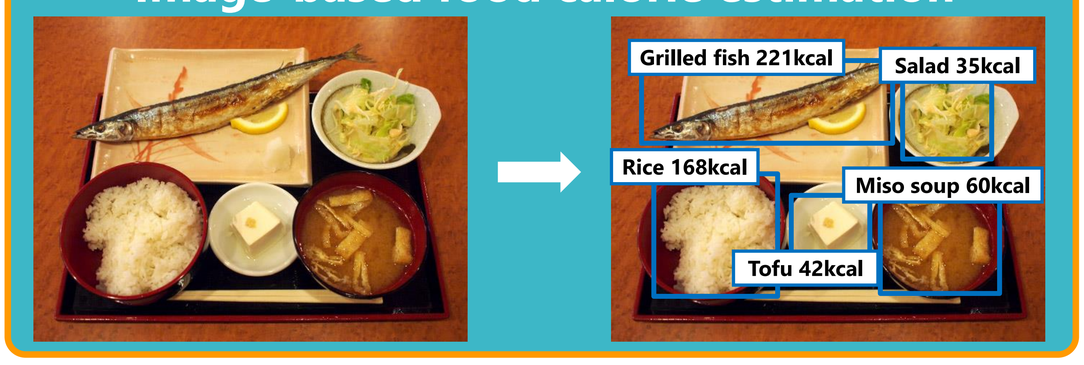
Background

- Fully-automatic food calorie estimation from a food photo has still remained an unsolved problem.
- Various methods have been proposed so far, but few studies have done which compare methods under the same conditions.

Purpose

- We compare two approaches of food calorie estimation from a food photo under close conditions to obtain useful approaches and new findings.

Image-based food calorie estimation

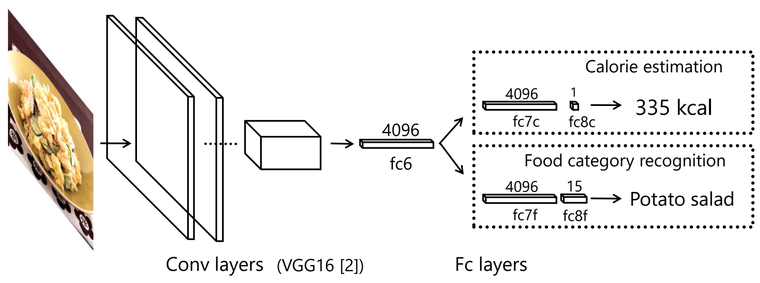


Method Regression-based / Search-based

Regression-based method

- 2017, we[1] proposed regression-based food calorie estimation with CNN.
- Multi-task learning of food calories and categories improved performance.
- Comparison with previous works have not been done.

➡ In this work we apply the method of [1] to VGG16 and ResNet50/101.



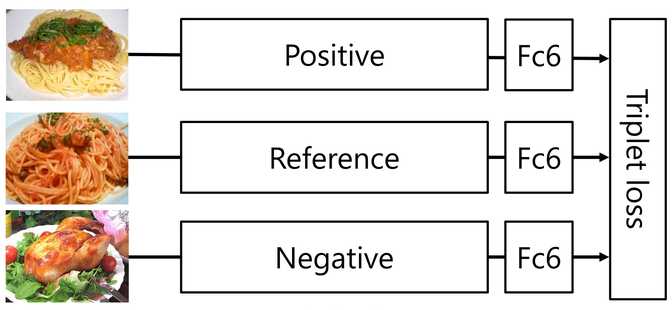
Multi-task CNN [1]

Search-based method

- 2011, Miyazaki et al.[2] proposed search-based food calorie estimation.
- They used conventional features such as SURF and color histogram for similar image search.

➡ In this work, we use features obtained from following models.

- VGG16 (pre-trained with ImageNet or UECFOOD100/256)
- VGG16 (finetuned with UECFOOD100/256 by triplet loss[3])
- VGG16 (finetuned with UECFOOD100/256 by triplet+classification loss[4])



Triplet loss [3]

Experiment

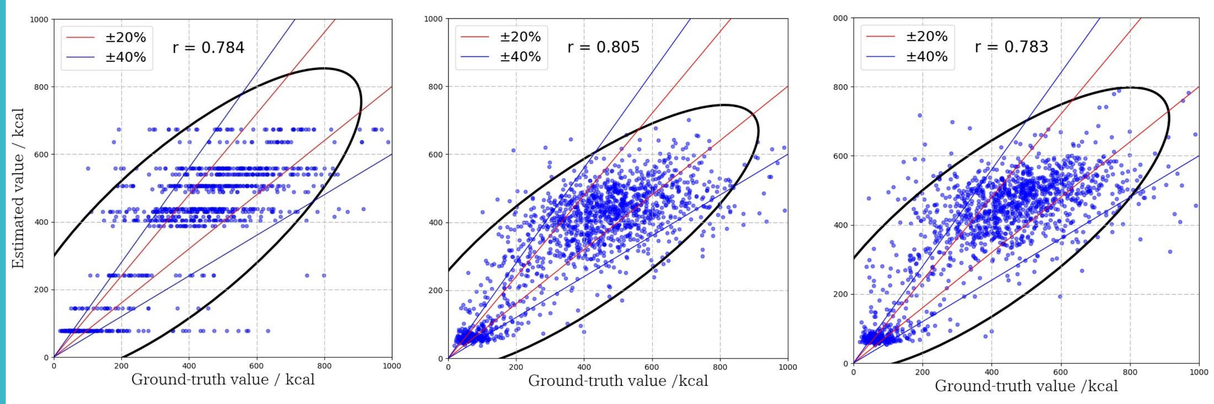
- Baseline (Classification)
  - Use of fixed calorie value of each category.
  - Train models with train images.
  - Evaluation with test images.
- Regression-based method
  - Train models with train images.
  - Evaluation with test images.
- Search-based method
  - Train models with UECFOOD100/256 dataset.
  - Use of train images to create database.
  - Evaluation with test images.

Calorie annotated food image dataset [3]

- Food 15 Category.
- Total of 4877 images. (7 : 3 = Train : Test)

Result

Correlation between estimated value and ground-truth



Baseline (fixed values) (Classification)

Regression-based (VGG16 multi-task)

Search-based (VGG16(ImageNet) fc6 triplet + cls)

	Model	Rel. err.	Abs. err.	Corr.	≤ 20%err.
Fixed	Baseline	32.4	**93.6**	0.784	**50.0**
Reg.	VGG16 single-task	29.2	100.4	0.783	46.0
Reg.	VGG16 multi-task	**28.0**	96.5	**0.805**	47.2
Sea.	VGG16(uecfood100) fc6	38.0	101.0	0.764	47.2
Sea.	VGG16(uecfood100) fc6 triplet	38.4	101.5	0.754	45.9
Sea.	VGG16(uecfood100) fc6 triplet + cls	36.7	98.6	0.777	48.1
Sea.	VGG16(ImageNet) fc6 triplet + cls	34.0	94.5	0.783	49.5

There are no clear differences among all the results.
The result by the simple baseline is also effective.

Conclusion

- We estimated food calories directly from a food photo by both methods of regression-based method and search-based method.
- We compared both methods.

Future work

- Image-based food calorie estimation based on amount of food.
- Combination of food calorie estimation and object detection.

[1] T. Ege and K. Yanai. Simultaneous estimation of food categories and calories with multi-task cnn. In Proc. of IAPR International Conference on Machine Vision Applications(MVA), 2017.
[2] T. Miyazaki, G. Chaminda, D. Silva, and K. Aizawa. Image - based calorie content estimation for dietary assessment. In Proc. of IEEE ISM Workshop on Multimedia for Cooking and Eating Activities, 2011.
[3] J. Wang, Y. Song, T. Leung, C. Rosenberg, J. Wang, J. Philbin, B. Chen, and Y. Wu. Learning fine-grained image similarity with deep ranking. In Proc. of IEEE Computer Vision and Pattern Recognition, 2014.
[4] E. Simo-Serra and H. Ishikawa. Fashion style in 128 floats: Joint ranking and classification using weak data for feature extraction. In Proc. of IEEE Computer Vision and Pattern Recognition, 2016.