Few-shot bioacoustic event detection: A new task at the DCASE 2021 challenge

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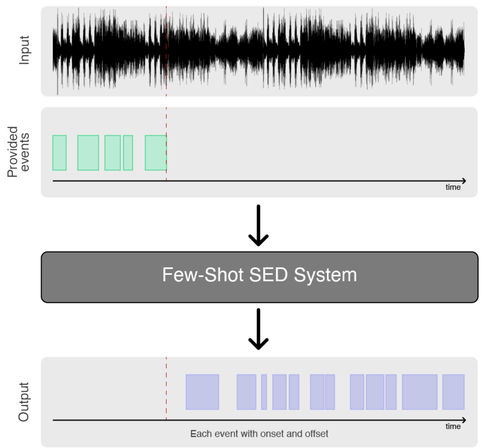
Bio
Task 5

An Important Problem

Few-shot bioacoustic event detection is a novel area of research that emerged from a need in monitoring biodiversity and animal behaviour: to annotate long recordings, that experts usually can only provide very few annotations for.



Baseline Methods

Template Matching:

- spectrogram cross-correlation method to find instances of a template in an image

Prototypical Network:

- N*-way-*k*-shot classification*, N is the number of classes and k the number of known samples per class
- class prototypes: Positive class: first 5 event annotations. Negative class: rest of the audio file.

Datasets

	Dataset	mic type	# audio files	total duration	# labels (excl. UNK)	# events (excl. UNK)
Development Set: Training	BV	fixed	5	10 hours	11	2,662
	HT	mobile	3	3 hours	3	435
	MT	mobile	2	70 mins	4	1,234
	JD	mobile	1	10 mins	1	355
Development Set: Validation	HV	mobile	2	2 hours	2	50
	PB	fixed	6	3 hours	2	260
Evaluation Set	ME	handheld	2	20 mins	2	70
	ML	various	17	20 mins	17	1,035
	DC	fixed	13	105 mins	3	967

Results

Rank	Team name	Evaluation set: F-score % (97.5% confidence interval)	Validation set: F-score %	DC F-score %	ME F-score %	ML F-score %
1	Zou_PKU [7]	**38.4** (36.2 - 40.6)	55.3	20.6	68.0	67.3
2	Tang_SHNU [6]	38.3 (36.1 - 40.5)	51.4	25.6	61.5	43.3
3	Anderson_TCD [1]	35.0 (33.1 - 37.0)	26.2	19.9	56.6	56.8
4	Baseline_TempMatch	34.8 (32.6 - 37.1)	2.0	**32.2**	47.1	29.5
5	Cheng_BIT [3]	23.8 (21.9 - 25.7)	46.3	10.6	53.5	**78.8**
6	Baseline_PROTO	20.1 (18.2 - 21.9)	41.5	8.5	**72.7**	55.7
7	Zhang_uestc [8]	16.8 (15.5 - 18.2)	54.4	8.1	45.1	29.9
8	Johannsmeier_OVGU [4]	15.2 (13.7 - 16.7)	**58.6**	6.5	64.3	35.8
9	Bielecki_SMSNG [2]	8.4 (7.1 - 9.7)	51.8	3.1	56.3	51.4

The best ranked system [7] applied a transductive inference method and adopted a mutual learning framework designed to make the feature extraction network more task dependent.

Second place [6] used data from Audioset to train a ResNet for feature extraction and adopted embedding propagation [5], for smoothing the decision boundaries as a way of increasing generalisation capabilities.

The third ranking system [1], followed the same approach as the prototypical network baseline, with the main differences being the use of data augmentation and reducing the size of the network.

Remarks

- All submitted systems adopted prototypical networks.
- Data augmentation was applied by the majority of the teams.
- All systems rely on some sort of post-processing mechanism designed to remove superfluous predictions.
- A popular choice was using Per-channel Energy Normalization (PCEN) as acoustic features.
- All systems are generally dataset sensitive.
- Drop in performance on the DC set of dawn chorus recordings.
- Better on ME and ML that include mainly mammal vocalisations.

References

[1] Mark Anderson and Naomi Harte. *Bioacoustic Event Detection with Prototypical Networks and Data Augmentation*. Tech. rep. DCASE2021 Challenge, June 2021.

[2] Radoslaw Bielecki. *FEW-SHOT BIOACOUSTIC EVENT DETECTION WITH PROTOTYPICAL NETWORKS , KNOWLEDGE DISTILLATION AND ATTENTION TRANSFER LOSS*. Tech. rep. DCASE2021 Challenge, June 2021.

[3] Hao Cheng, Chenguang Hu, and Miao Liu. *PROTOTYPICAL NETWORK FOR BIOACOUSTIC EVENT DETECTION VIA I-VECTORS*. Tech. rep. DCASE2021 Challenge, June 2021.

[4] Jens Johannsmeier and Sebastian Stober. *FEW-SHOT BIOACOUSTIC EVENT DETECTION VIA SEGMENTATION USING PROTOTYPICAL NETWORKS*. Tech. rep. DCASE2021 Challenge, June 2021.

[5] Pau Rodrıguez et al. “Embedding propagation: Smoother manifold for few-shot classification”. In: *European Conference on Computer Vision*. Springer. 2020, pp. 121–138.

[6] Tiantian Tang, Yunhao Liang, and Yanhua Long. *TWO IMPROVED ARCHITECTURES BASED ON PROTOTYPE NETWORK FOR FEW-SHOT BIOACOUSTIC EVENT DETECTION*. Tech. rep. DCASE2021 Challenge, June 2021.

[7] Dongchao Yang et al. *FEW-SHOT BIOACOUSTIC EVENT DETECTION: A GOOD TRANSDUCTIVE INFERENCE IS ALL YOU NEED*. Tech. rep. DCASE2021 Challenge, June 2021.

[8] Yue Zhang et al. *FEW-SHOT BIOACOUSTIC EVENT DETECTION USING PROTOTYPICAL NETWORK WITH BACKGROUND CLASSs*. Tech. rep. DCASE2021 Challenge, June 2021.

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