Combining textual and visual features into multiple joint latent spaces, and introducing dual softmax re-ranking, for Ad-hoc Video Search

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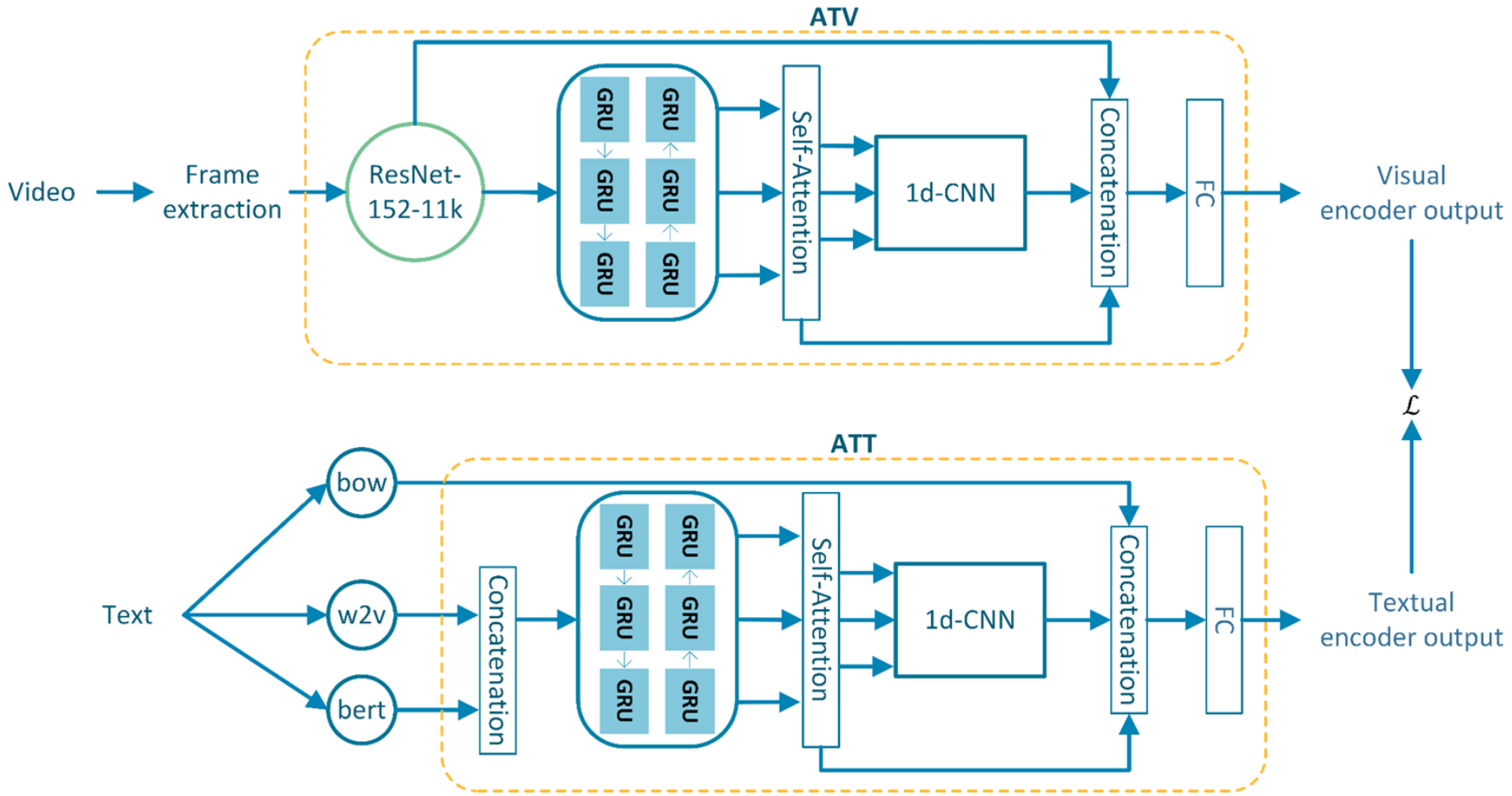
Problem statement

- Retrieving video shots using natural-language textual queries
  - *“Find a shot of a man with a white beard”*

Our 2021 model

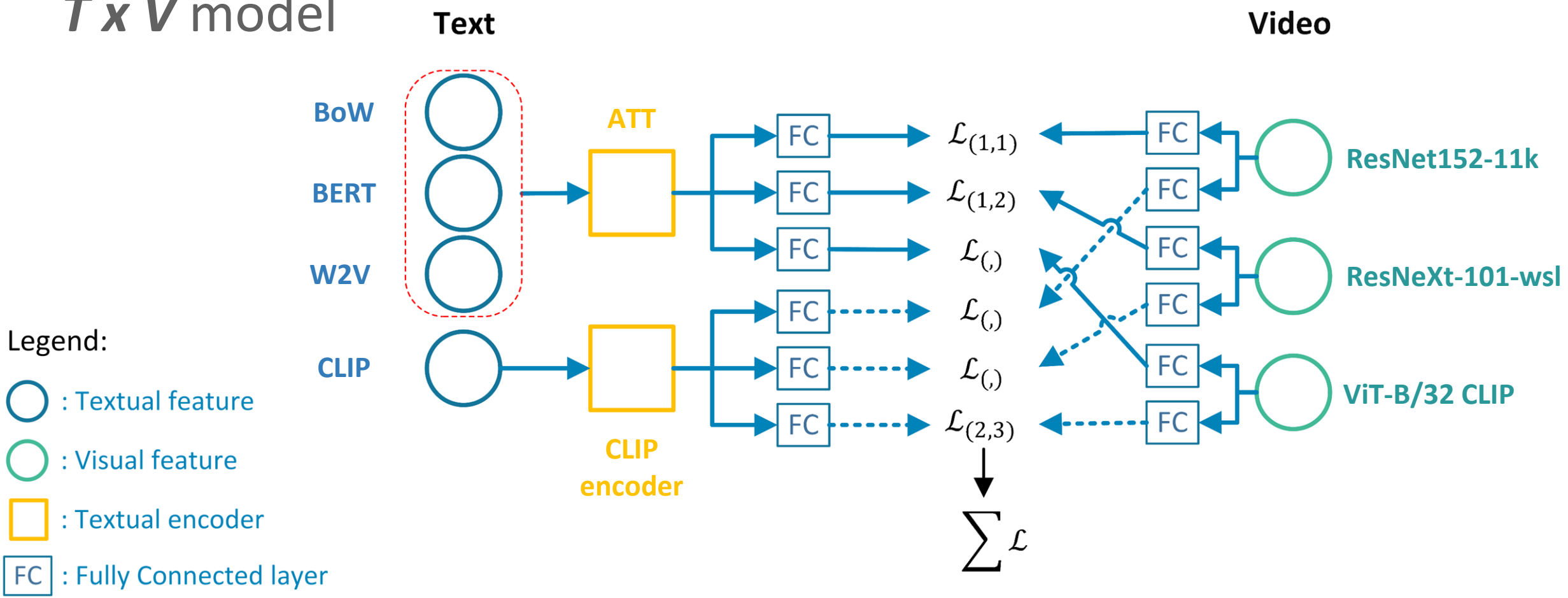


Our 2022 approach

- We utilize the T x V cross-modal network
- Combination of textual and visual features
- Multiple latent spaces development
- Multi-loss-based learning
- Similarity revision using a dual softmax operation

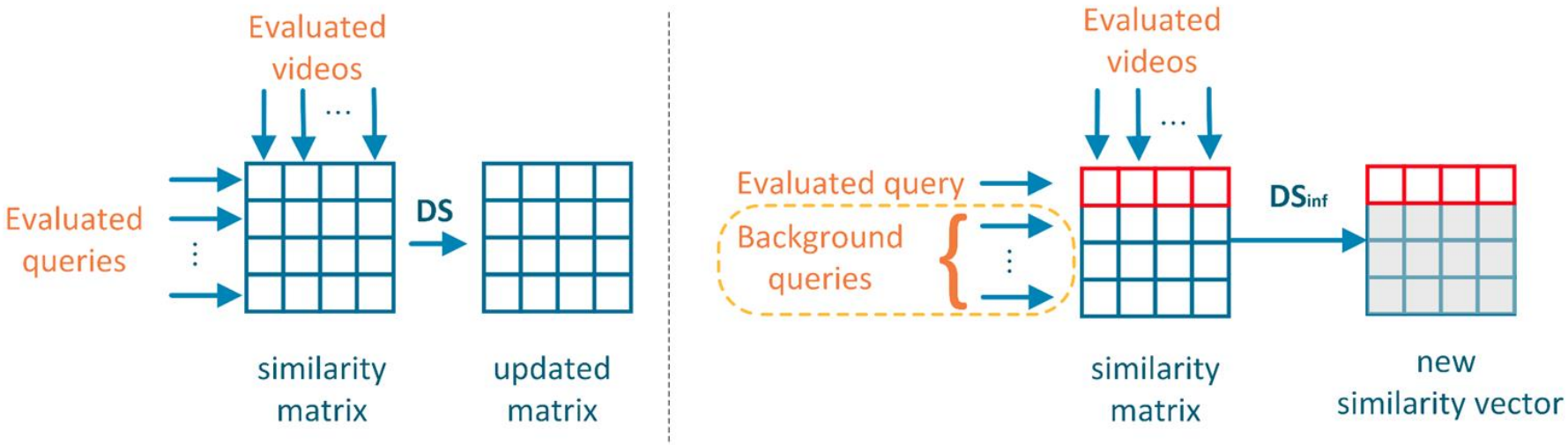
Our 2022 approach

T x V model



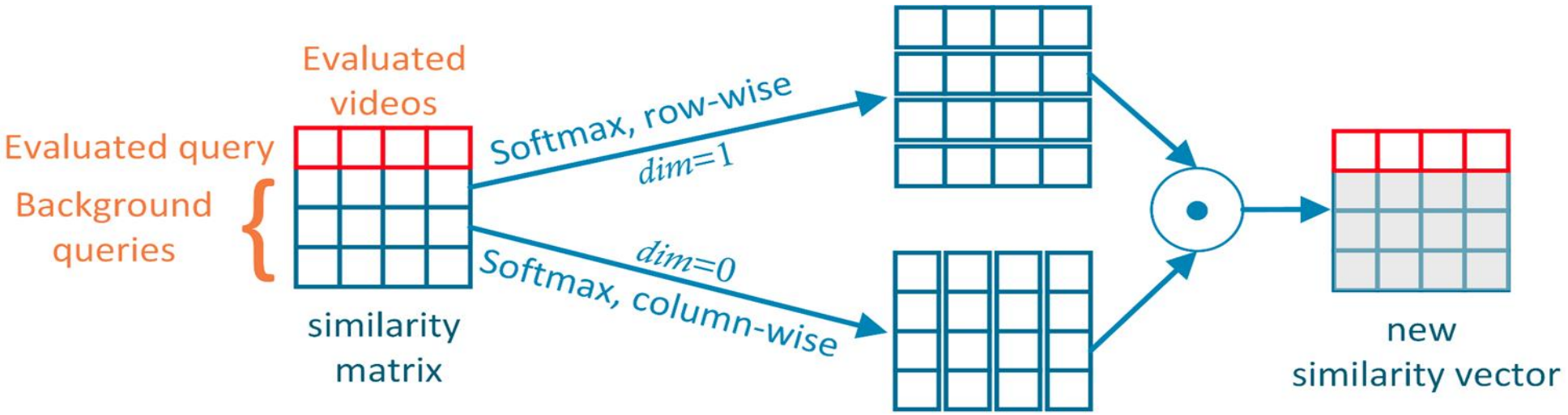
Dual Softmax Inference

- Query-video similarities revision
- Inspired by the Dual Softmax loss
- Two approaches:
  - Evaluation with *a priori* knowledge of all queries
  - Query-agnostic evaluation



Dual Softmax Inference

- Two different background queries strategies
  - AVS 2022 queries
  - AVS 2019-2020-2021 queries



Features and encoders

- Textual Features
  - Bag-of-words
  - BERT
  - Word2Vec
  - ViT-B/32 CLIP
- Textual Encoders
  - Attention-based dual encoding network (ATT)
  - ViT-B/32 CLIP encoder

Features and encoders

- Visual Features
  - **ResNet-152** trained on the ImageNet11k dataset
  - **ResNeXt-101** re-trained by weakly supervised learning on web images and fine-tuned on ImageNet
  - **ViT-B/32 CLIP** model

Datasets and metrics

- Datasets:
  - Training: MSR-VTT, TGIF, ActivityNet Captions and Vatex
  - Evaluation:
    - V3C2 evaluated on TRECVID AVS 2022 queries
    - V3C1 evaluated on TRECVID AVS 2019-2021 queries
    - IACC.3 evaluated on TRECVID AVS 2016-2018 queries
- Evaluation metric:
  - Mean extended inferred average precision (MXinfAP)

Submitted runs

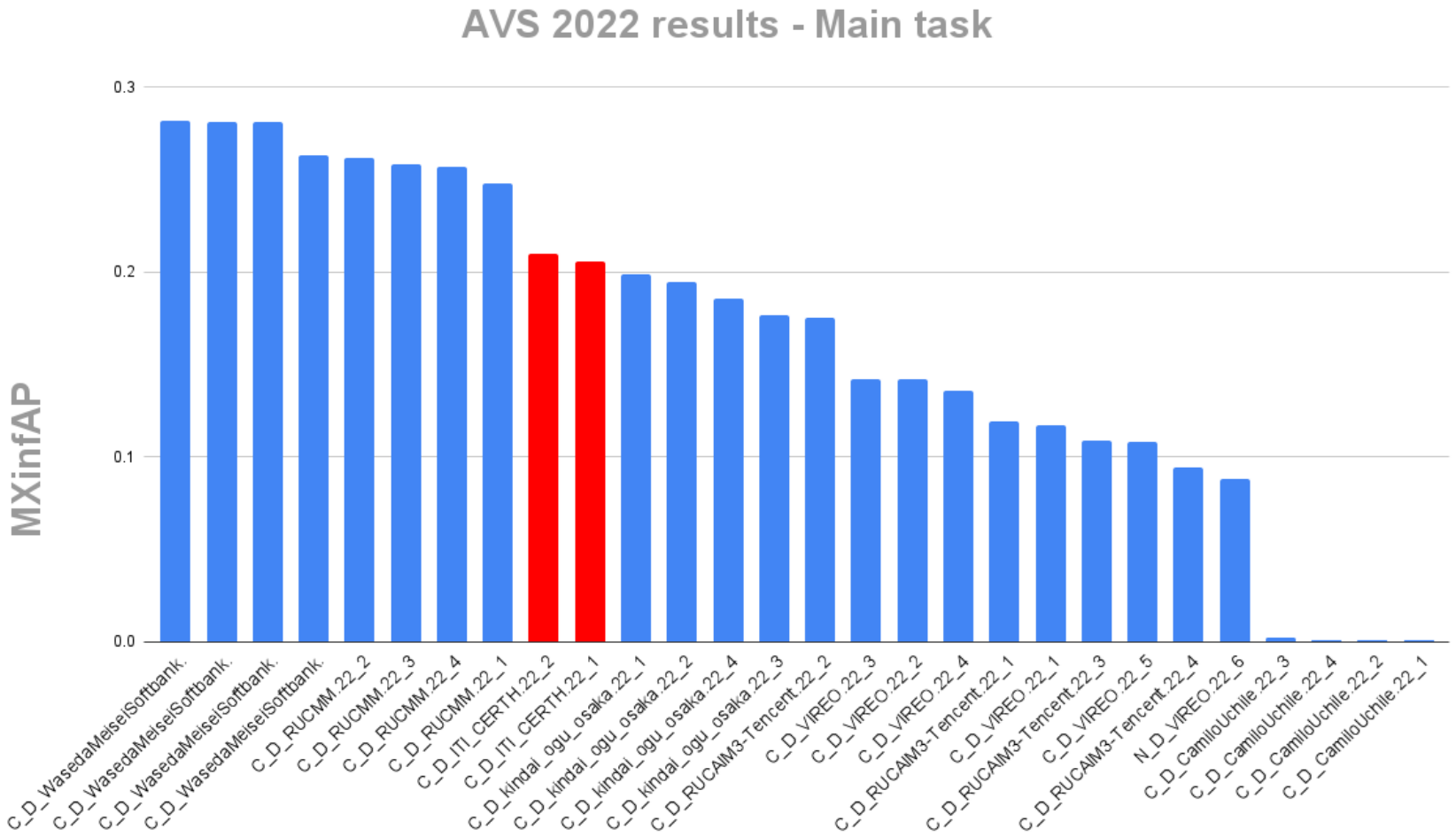
- **ITI_CERTH.22_run_2**:
  - ***T x V*** model with 2 textual encoders and 3 visual features
  - Late fusion of 6 trained models with different configurations
  - Dual softmax using all AVS2022 queries as background queries
- **ITI_CERTH.22_run_1:**
  - Similar to run #2
  - Dual softmax using AVS 2019-2021 queries as background

Results

Model	Dataset						
	IACC.3			V3C1			V3C2
	AVS16	AVS17	AVS18	AVS19	AVS20	AVS21	AVS22
T×V	0.234	0.317	0.153	0.220	0.316	0.312	0.194
T×V + DS on the set of evaluated queries (run #2)	**0.244**	**0.330**	**0.165**	**0.226**	0.324	**0.324**	**0.210**
T×V + DS using other years' queries of the same dataset (run #1)	0.243	0.328	0.162	**0.226**	**0.325**	0.323	0.206

MXinfAP for all submitted runs and TxV baseline for the fully-automatic AVS task.

Results



AVS 2022 ranking list of all submitted runs regarding the main task in MXinfAP terms. Red bars indicate our submitted runs.

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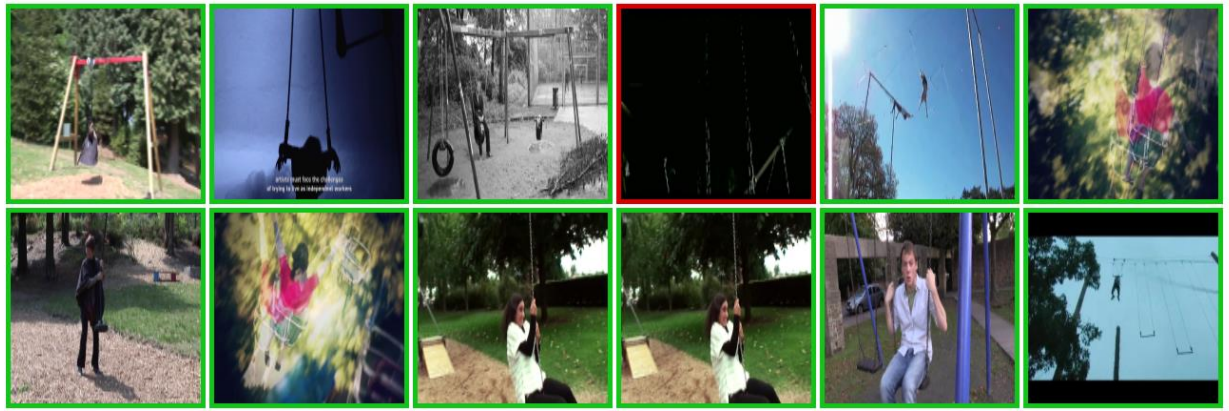
Dual Softmax impact

“A person is in the act of swinging”

T x V model



T x V model with DS (run #2)

Dual Softmax impact

“A drone landing or rising from the ground”

T x V model

T x V model with DS (run #2)

Dual Softmax impact

“A type of cloth hanging on a rack, hanger, or line”

T x V model

T x V model with DS (run #2)

Conclusions

- We utilize the cross-modal TxV network
- We combine multiple textual and visual features
- The dual softmax operation boosts the performance
- The *a priori* knowledge of evaluation queries benefits the performance
- A query-agnostic dual softmax revision serves real-life scenarios, with a small trade-off regarding the overall performance

Thank you!

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