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Automatic Construction and Evaluation of multi-video Summaries

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Video Summaries

- A summary is a subset of the video
  - Identify important information
- A summary can be good or bad
  - Depends on task
  - Quality is generally difficult to evaluate
- Multi-video summaries
  - Useful for correlated videos (TV series)
  - Remove redundancy

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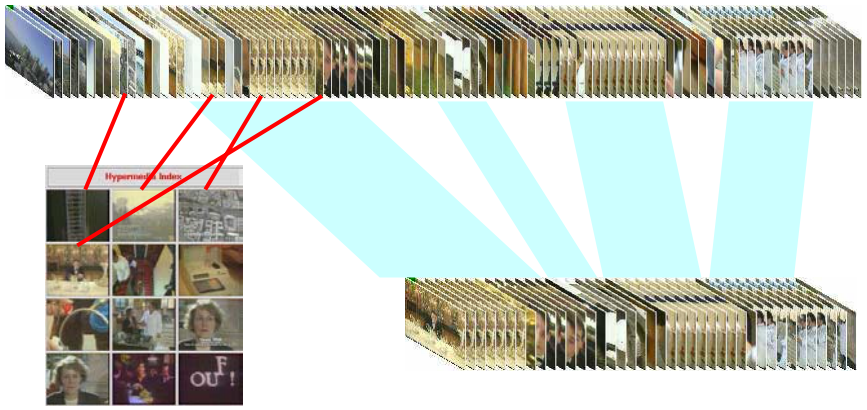
Video Summary format



keyframe set

video skim

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Maximal Recall Task

- Idea: identify movie from picture in magazine
- Formalization:
  - User u knows summaries S_i of video V_i
  - User u is shown an excerpt E (from video V_j)
  - User u is asked to guess j
- Optimal summaries:
  - Should maximize the performance over all E
  - Evaluation can be automated if the behavior of u can be reasonably simulated

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Maximal Visual Recall

- User chooses video j if he recognises similar images in excerpt E and summary S_j
- In case of ambiguity: no decision
- This process can be automated based on similarity measure
- Similarity based on color histograms

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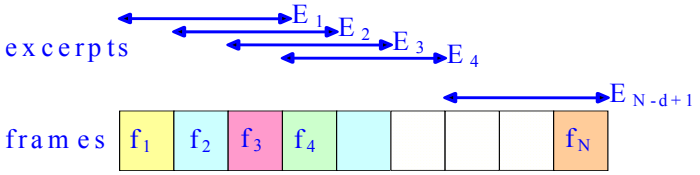
Formal Description



- Unknown case:

$$\forall v' \quad \forall f_j \in E_i^v \quad \forall f_m \approx f_j \quad f_m \notin S_{v'}$$

- Ambiguous case:

$$\exists v' \exists v'' \neq v' \ \exists j \quad f_j \in E_i^v \quad \exists f_m, f_n \approx f_j \text{ and } f_m \in S_{v'} \text{ and } f_n \in S_{v''}$$

- Unambiguous case:

$$\exists v' \ \exists j \quad f_j \in E_i^v \ \exists f_m \approx f_j \text{ and } f_m \in S_{v'}, \forall v'' \neq v' \forall f_j \in E_i^v \ \forall f_m \approx f_j \quad f_m \notin S_{v''}$$

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Summary construction

1) Iterative process
   - Greedy algorithm
   - Selection based on frame coverage

2) In-place refinement
   - Try to replace each frame individually to improve quality
   - Repeat until no change

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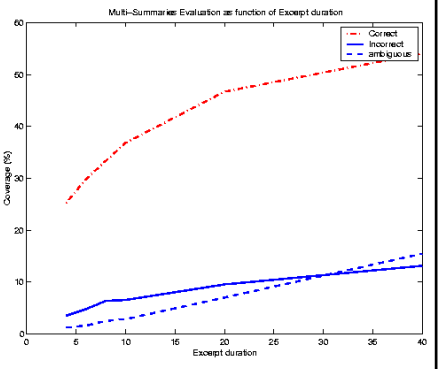
Experimental results

Coverage over the original videos

Excerpt duration	% correct	% ambiguous	% incorrect
4 sec	25.25	1.27	3.53
6 sec	29.87	1.61	4.79
8 sec	33.36	2.51	6.38
10 sec	36.82	2.86	6.54
20 sec	46.70	7.02	9.54
40 sec	54.06	15.47	13.14

Evaluation of summaries



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Conclusion

- Novel approach to automated video summary creation
- New method for evaluation
  - Use of the Simulated User
  - Performance levels are easy to understand
- New method for summary creation
  - Suboptimal automatic construction
  - Summary duration is user definable
- Experiments with Multi-video summaries