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IMAGE SEGMENTATION FOR IMPROVED LOSSLESS SCREEN CONTENT COMPRESSION

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Introduction to SCF

- **S**oft **C**ontext **F**ormation (SCF).
- Single pixel coding. Pixels are coded in raster scan order in one of three stages.
- Probability distribution model, fully adaptive arithmetic coding.

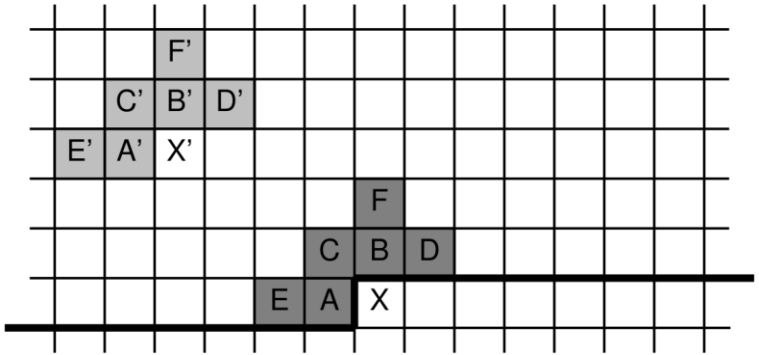


Fig 1: Context representation

X'– Already encoded pixel
X – Current pixel to encode
A to F – Neighbours

Introduction to SCF

- **Stage 1**: If the colour of X has already appeared in combination with a *pattern* that is similar to its current one, X is code in Stage 1.
- **Stage 2**: If the colour of X has already been seen in the image, it can be encoded in Stage 2 based on the *global colour* palette.
- **Stage 3**: This stage tries to predict the three colour components separately and maintains probability distributions for prediction errors. Using Median Adaptive Predictor (MAP).

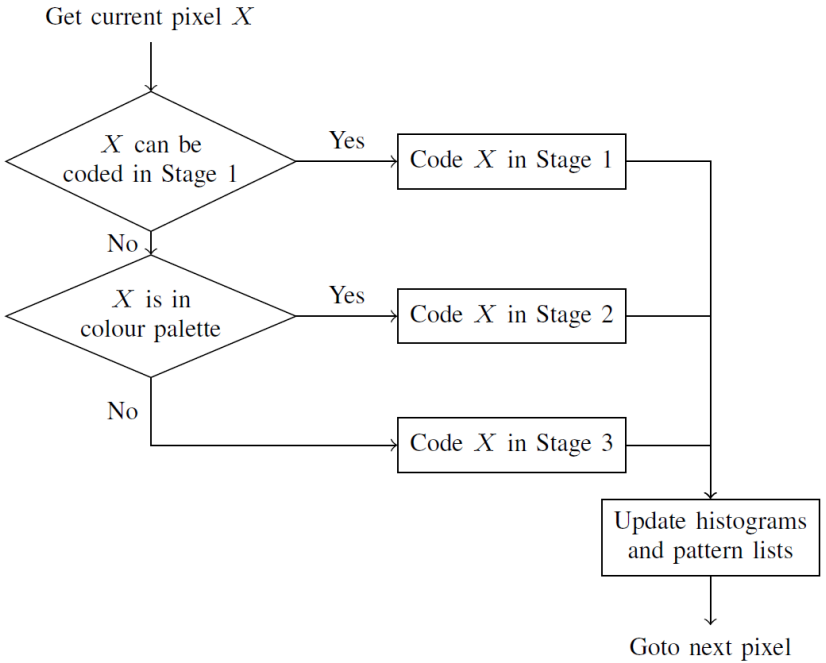
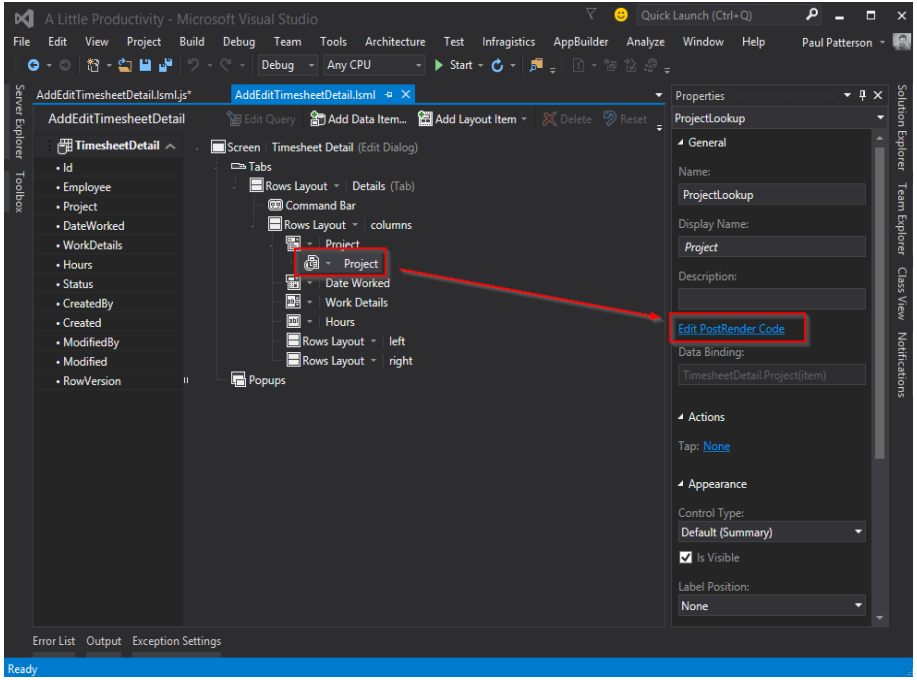


Fig 2: SCF coding stages [3][4]

Synthetic Screen Content Images (SCI's)



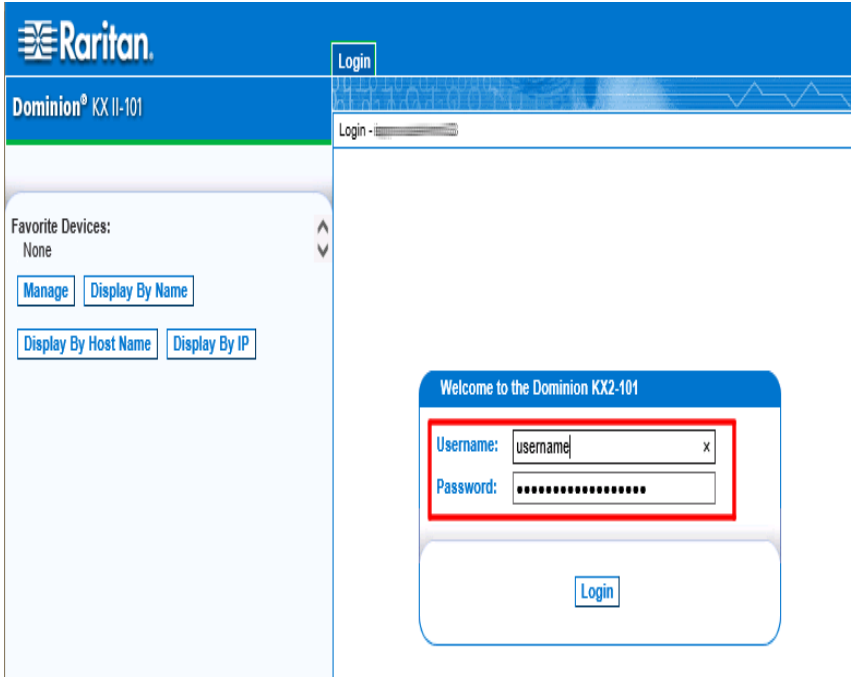
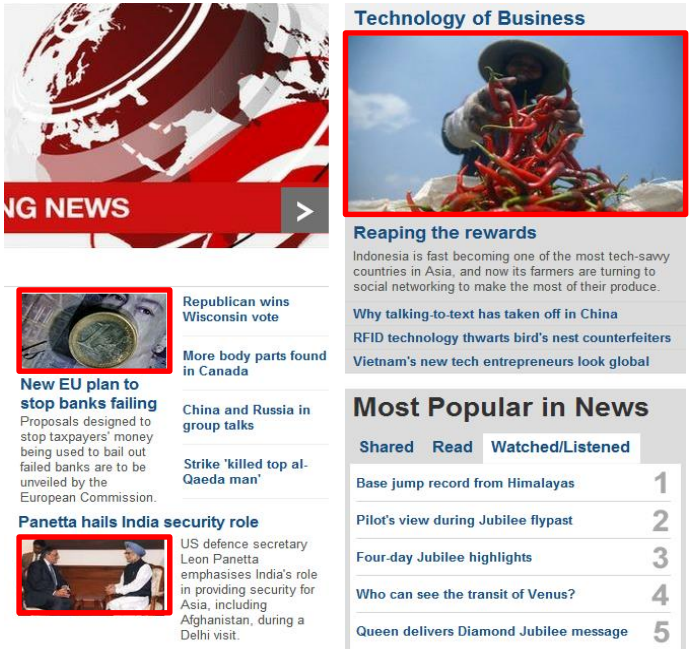


Fig 3: Examples of Synthetic SCI's

Compound Screen Content Images (SCI‘s)



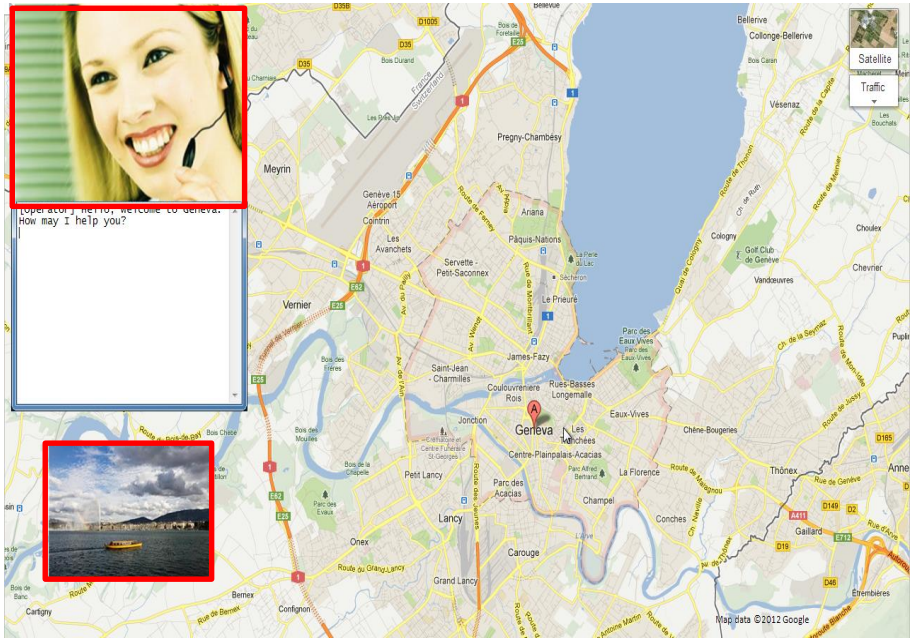
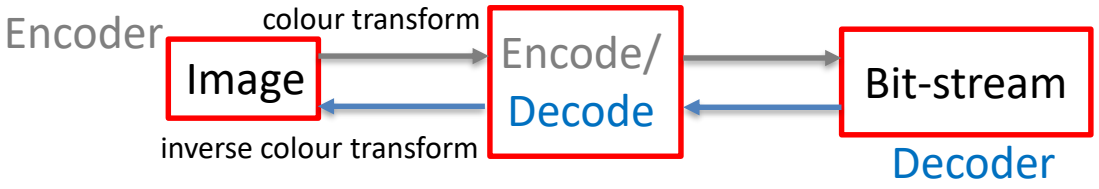


Fig 4: Examples of Compound SCI‘s

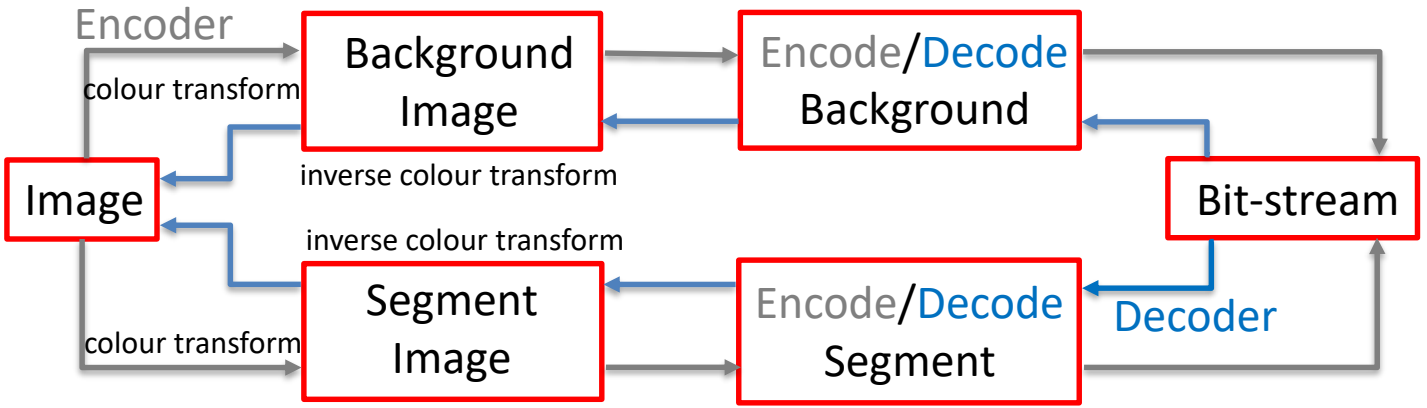
Segmentation

- ❑ Compound SCIs make estimation of proper distributions difficult.
- ❑ Segmentation algorithm to detect and extract natural regions.
- ❑ Synthetic background and natural segments are coded separately.

SCF Workflows



SCF Workflow



Segmenation based SCF Workflow

Segmentation Stages

Segmentation- Block Classification

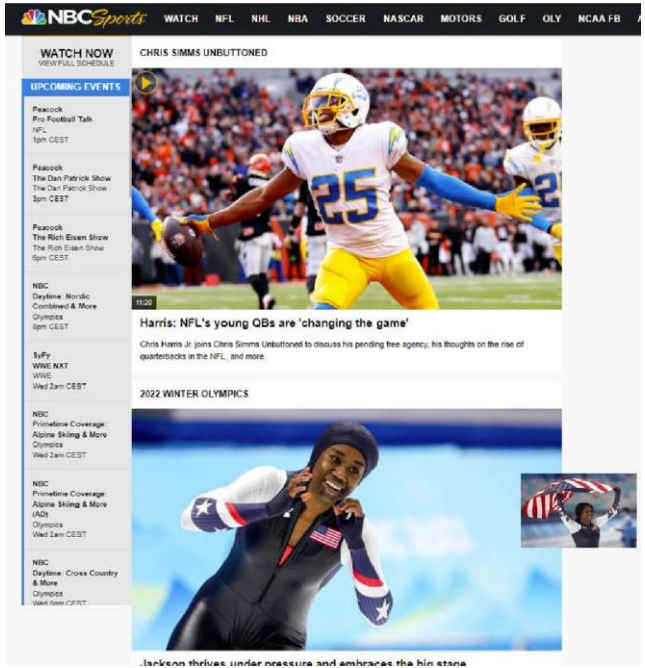


Fig 5.1: Original image

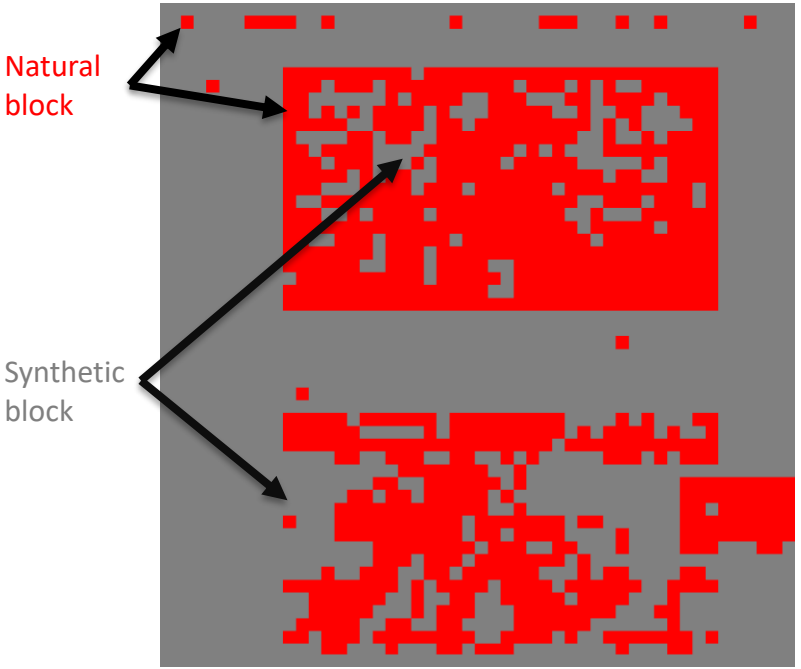


Fig 5.2: Block classification

Segmentation- Initial Bounding Boxes

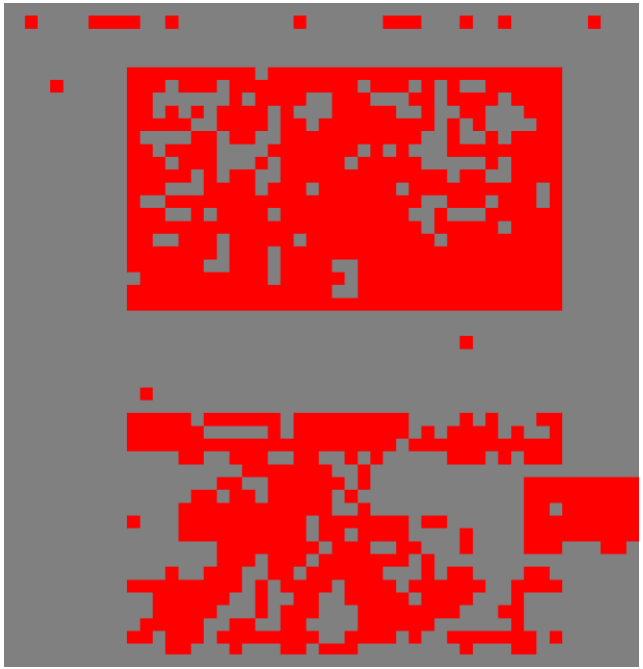


Fig 5.2: Block classification

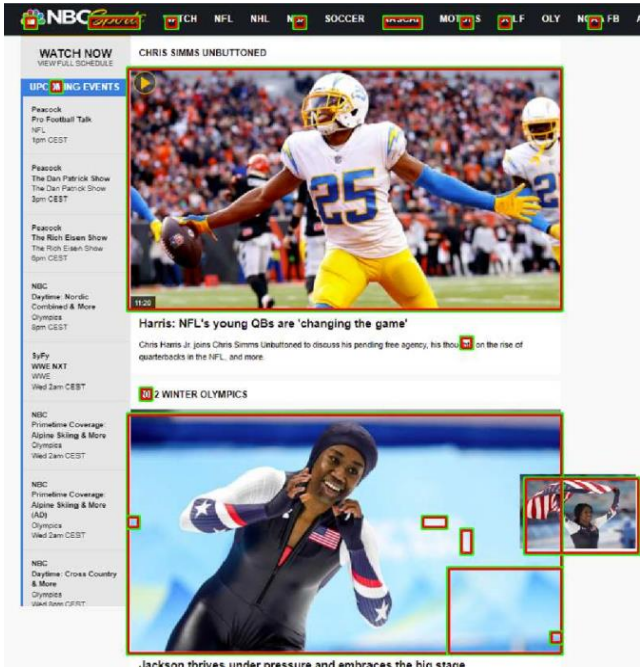


Fig 5.3: Inital bounding boxes

Segmentation- Area Threshold

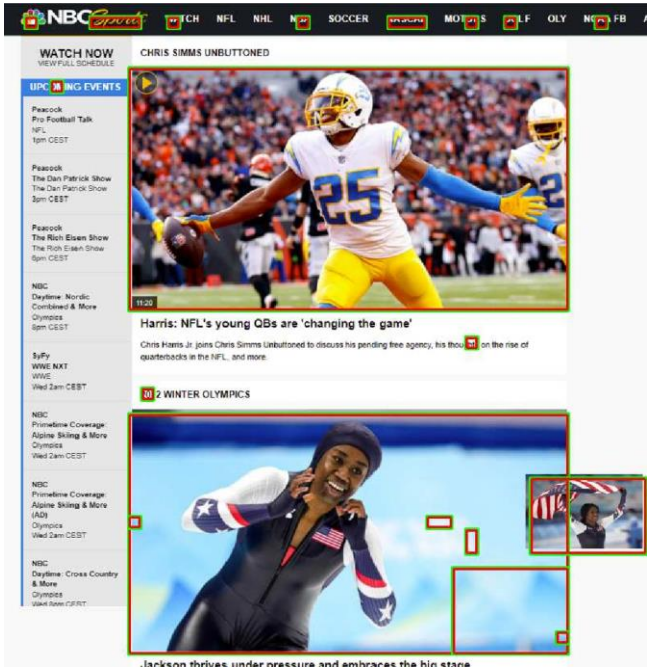


Fig 5.3: Initial bounding boxes

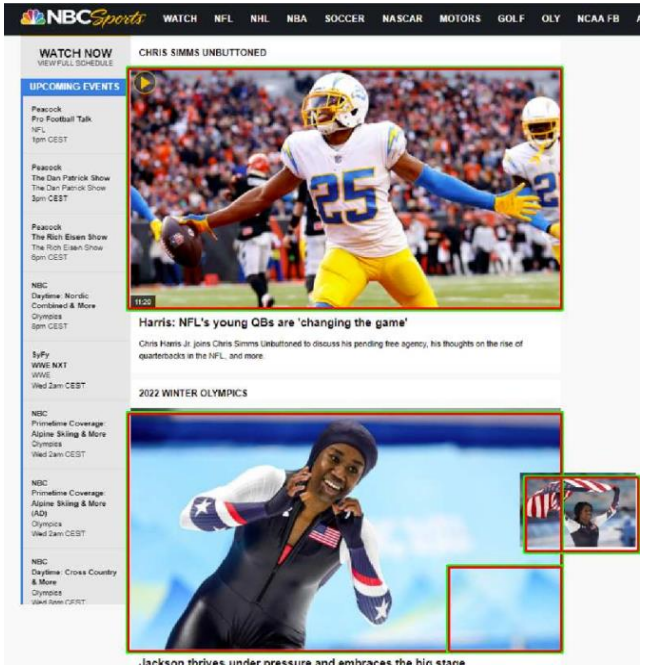


Fig 5.4: Remove overlap

Segmentation- Bounding box refinements (Overlap)

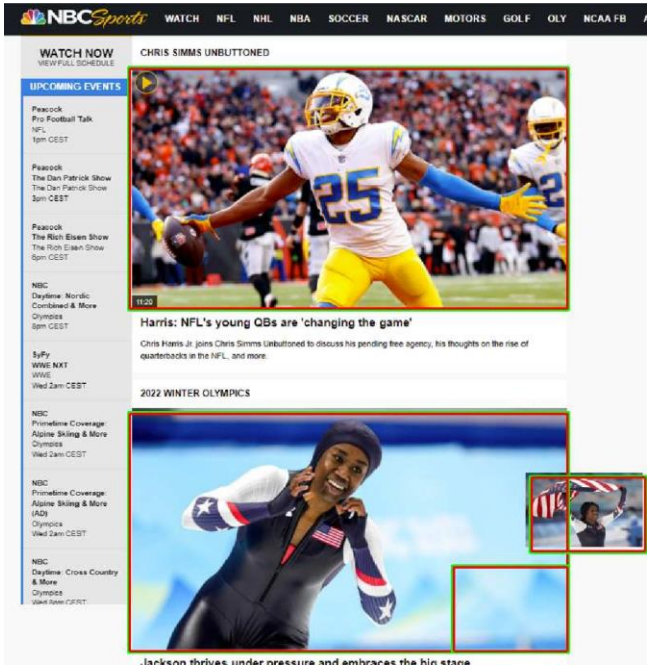


Fig 5.4: Area threshold

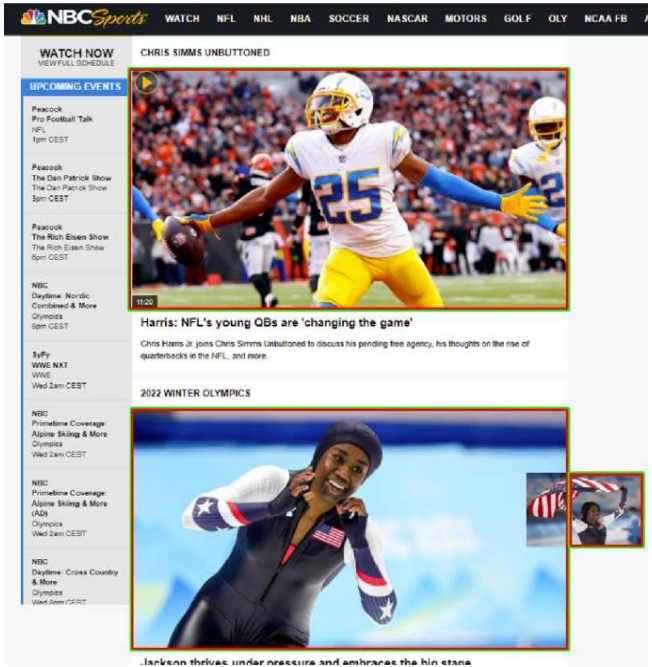
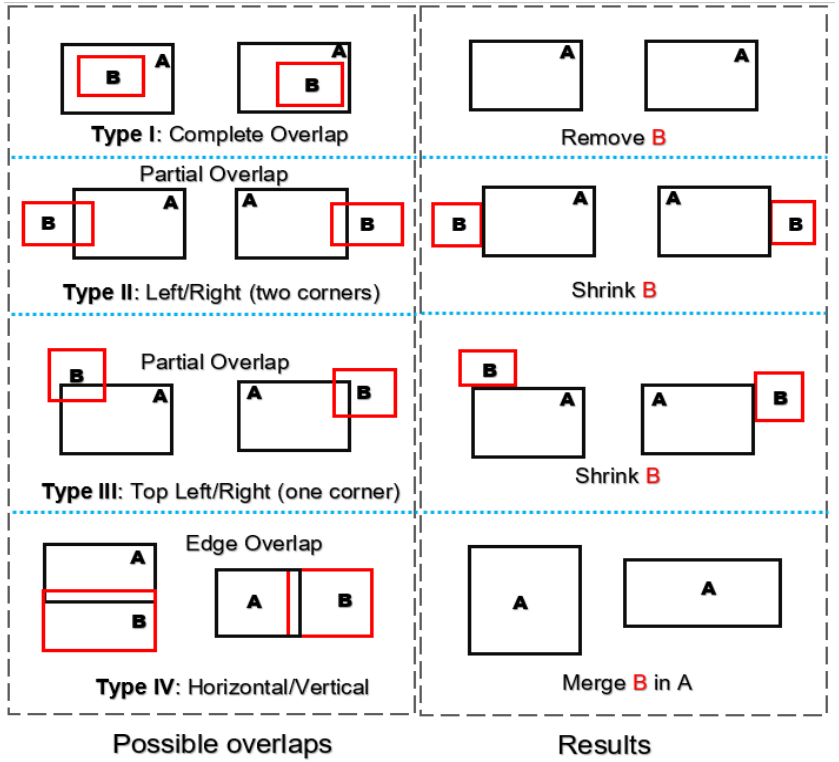


Fig 5.5a: Remove overlap

Segmentation- Overlap removal



Segmentation- Bounding box refinements (Border)

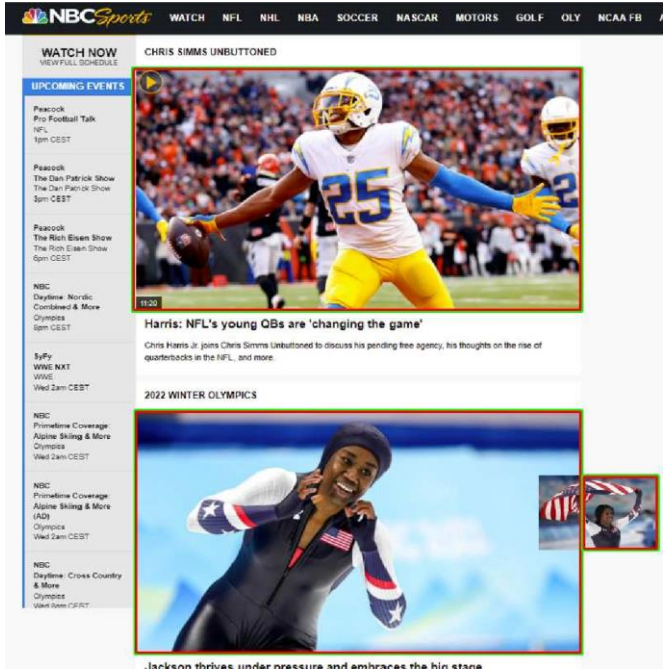
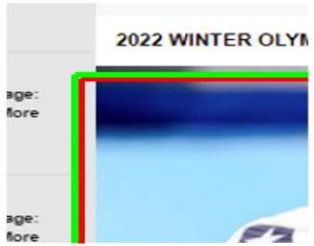


Fig 5.5b: Border refinement



Before

After

Fig 5.5c: Enlarged parts of 3.5b

Segmentation- Synthetic and Natural Regions

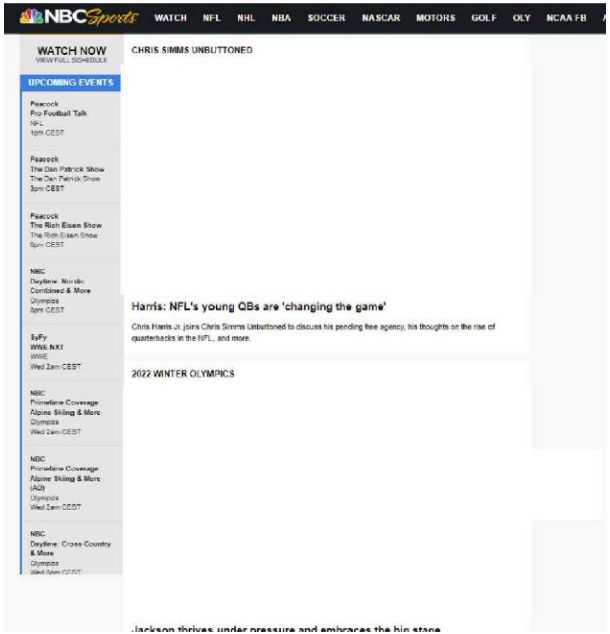


Fig 5.6: Synthetic background Image

Fig 5.7: Natural segment Image

Evaluation

- Proposed SCF version is compared to HEVC (HM-16.21+SCM-8.8) and previous version of SCF
- Investigated a collection of 150 SCI's.
- Compared to HEVC (HM-16.21+SCM-8.8), previous SCF version achieves 11.06% bit rate savings on average
- Proposed segmentation approach improves 1.52% w.r.t previous SCF version
- Test sets are available at [10]

Results

	No. of Images	HM-16.21 SCM-8.8 [1][2]	Previous SCF [3]	Proposed SCF
Test-Set Percentage	150	42912198 bytes **111.06%**	39055397 bytes **101.52%**	38470760 bytes **100.00%**

Comparison of the compression performances of proposed method (SCF) with HEVC (HM-16.21+SCM-8.8) and previous version of SCF.

Conclusion

- Coding synthetic and natural regions separately helps in better estimation of probability models
- The current version only detects natural segments within synthetic background images
- In future work, we would like to extend our approach to segment synthetic regions from natural background images
- Atleast a third class should be considered representing rendered images that are computer generated but still contain a very high number of colours
- Extend the segmentation algorithm to deal with other shapes than rectangles/squares

Thank you

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