

A Hybrid View Synthesis Method for View Interpolation and Extrapolation

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a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA





Main Issue with View Synthesizing Process



Left View



Right View

- Areas of the background can be occluded by foreground objects in one or more of the available views but can become visible in the synthesized views



Main Issue with View Synthesizing Process



Real View

- This problem is more severe in the case of extrapolation.



Digital Multimedia
Lab

View Synthesis Reference Software (VSRS)

Left Video
+ Depth



Right Video
+ Depth



Shifting based on depth



Hole filling with data from other view



Interpolation of occluded areas



Smoothing of final image



Synthesized
Video

Problem with VSRS

- Interpolation using inpainting produces similar colour to the true view but does not take into account the texture which is missing from the final version



Nonlinear Disparity Mapping (Warping)

- A saliency map is generated which separates areas based on visual importance
- No full depth map is needed only a sparse set of disparity cues
- Original frame is warped using an image warping technique

Original frame



Sparse set of disparity cues



“Warped” 3D view



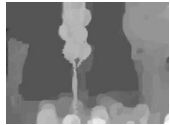
Issues With Nonlinear Disparity Mapping



- Strong and frequent changes in disparity lead to distortions
- Large disparity also leads to distortions



Our Proposed Interpolation Hybrid Approach



Closer View
+Depth

Create
Primary
Synthesized
View

Available
Views +
Depth

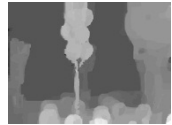
Farther View
+Depth



- We create a primary synthesized view based on the closest camera view and its depth map
- The appropriate shifting amount for different objects in the scene is calculated using the depth and texture information by the same formula as used in VSRS



Our Proposed Interpolation Hybrid Approach



Closer View
+Depth

Available
Views +
Depth

Create
Primary
Synthesized
View



Synth View I
with Holes

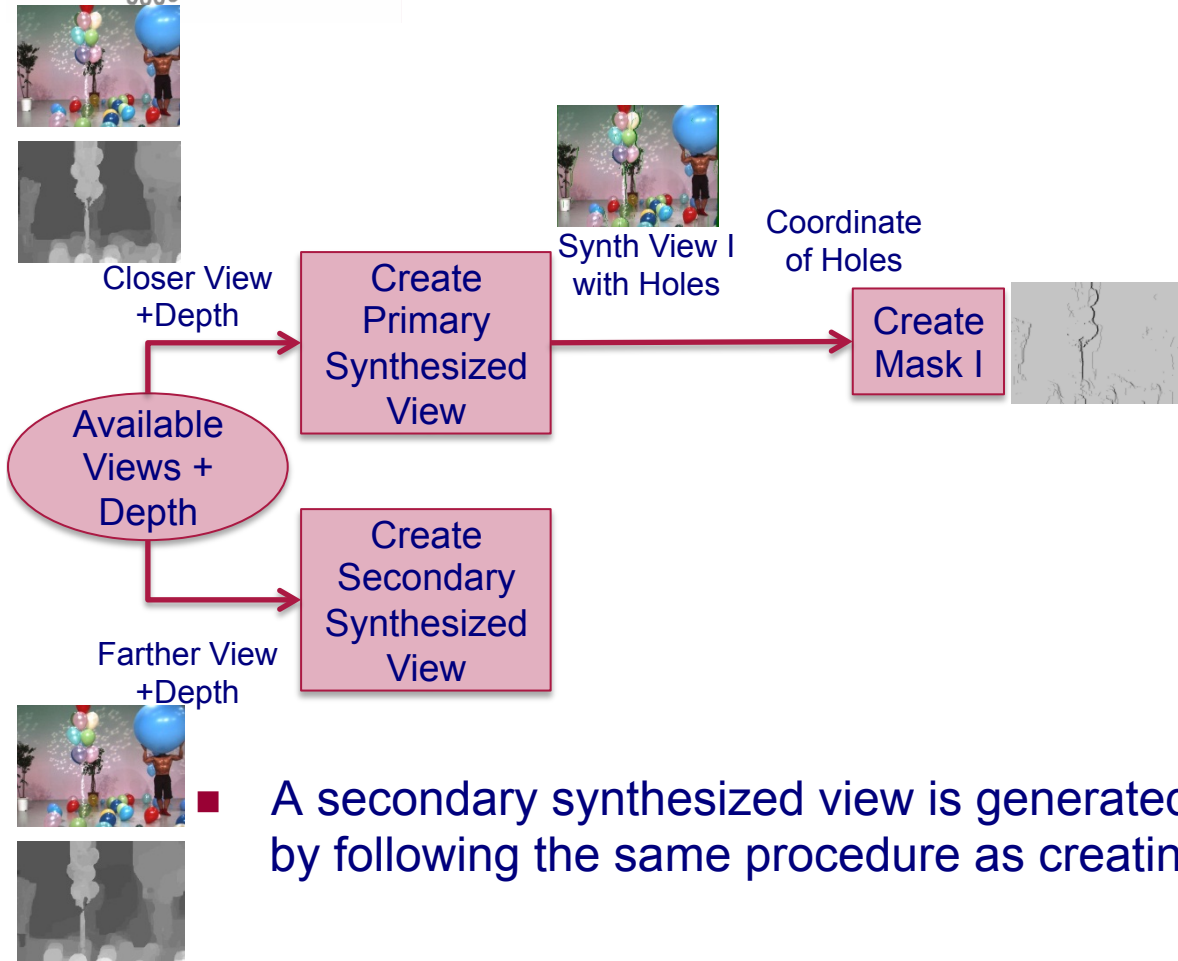
Create
Mask I

Farther View
+Depth



- A mask is created to map the location of holes in the primary view

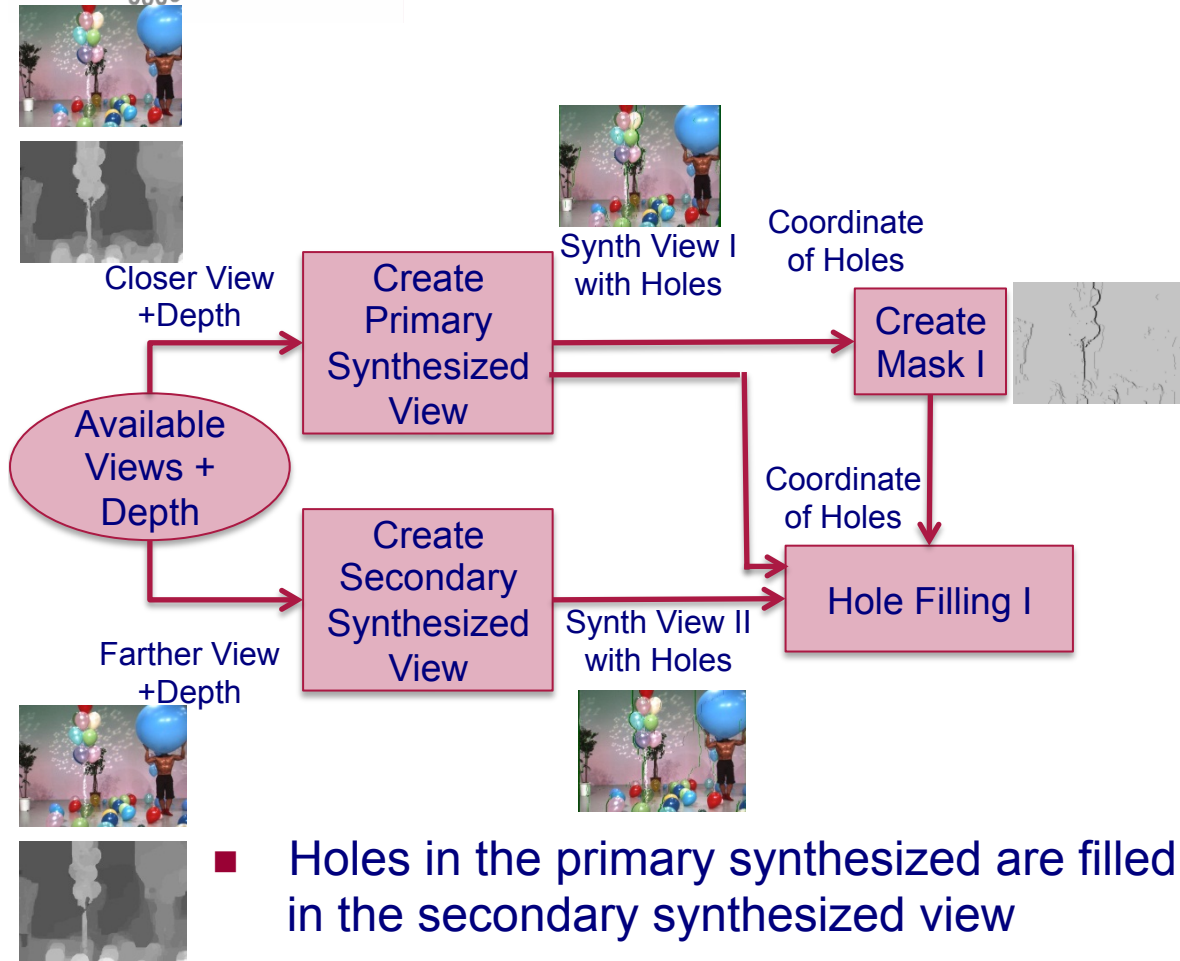
Our Proposed Interpolation Hybrid Approach



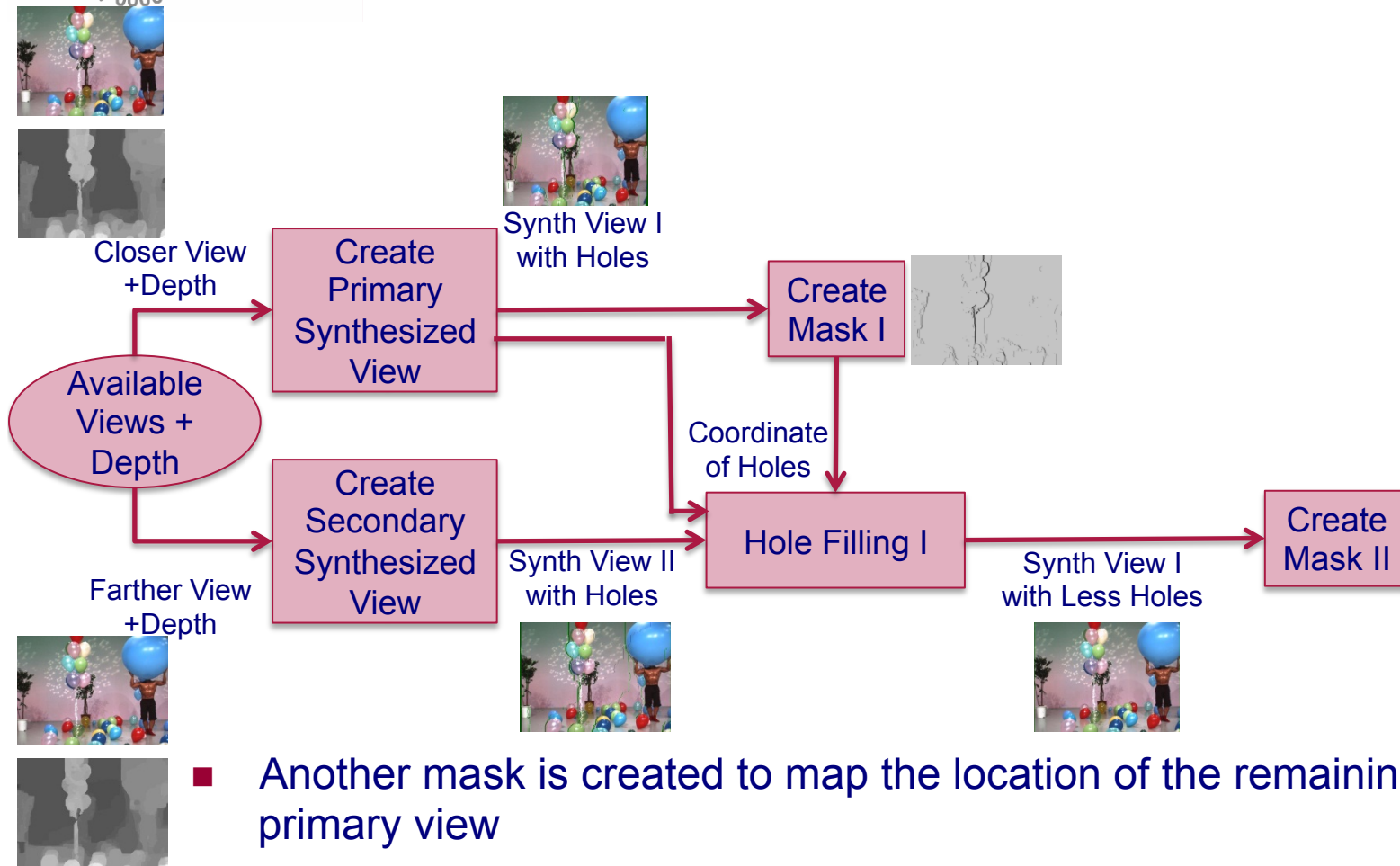
■ A secondary synthesized view is generated solely based on the farther view by following the same procedure as creating the primary synthesized view

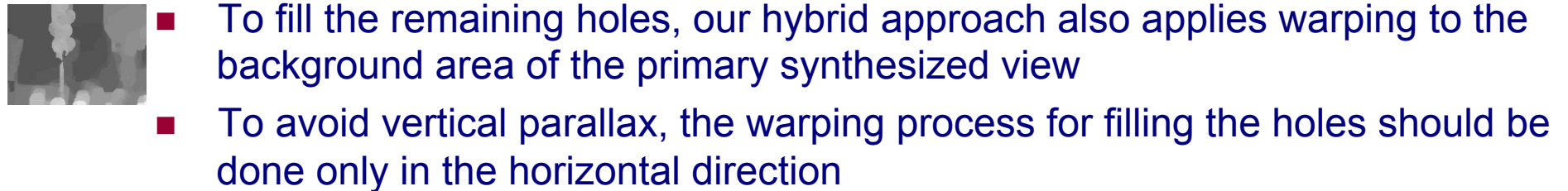


Our Proposed Interpolation Hybrid Approach



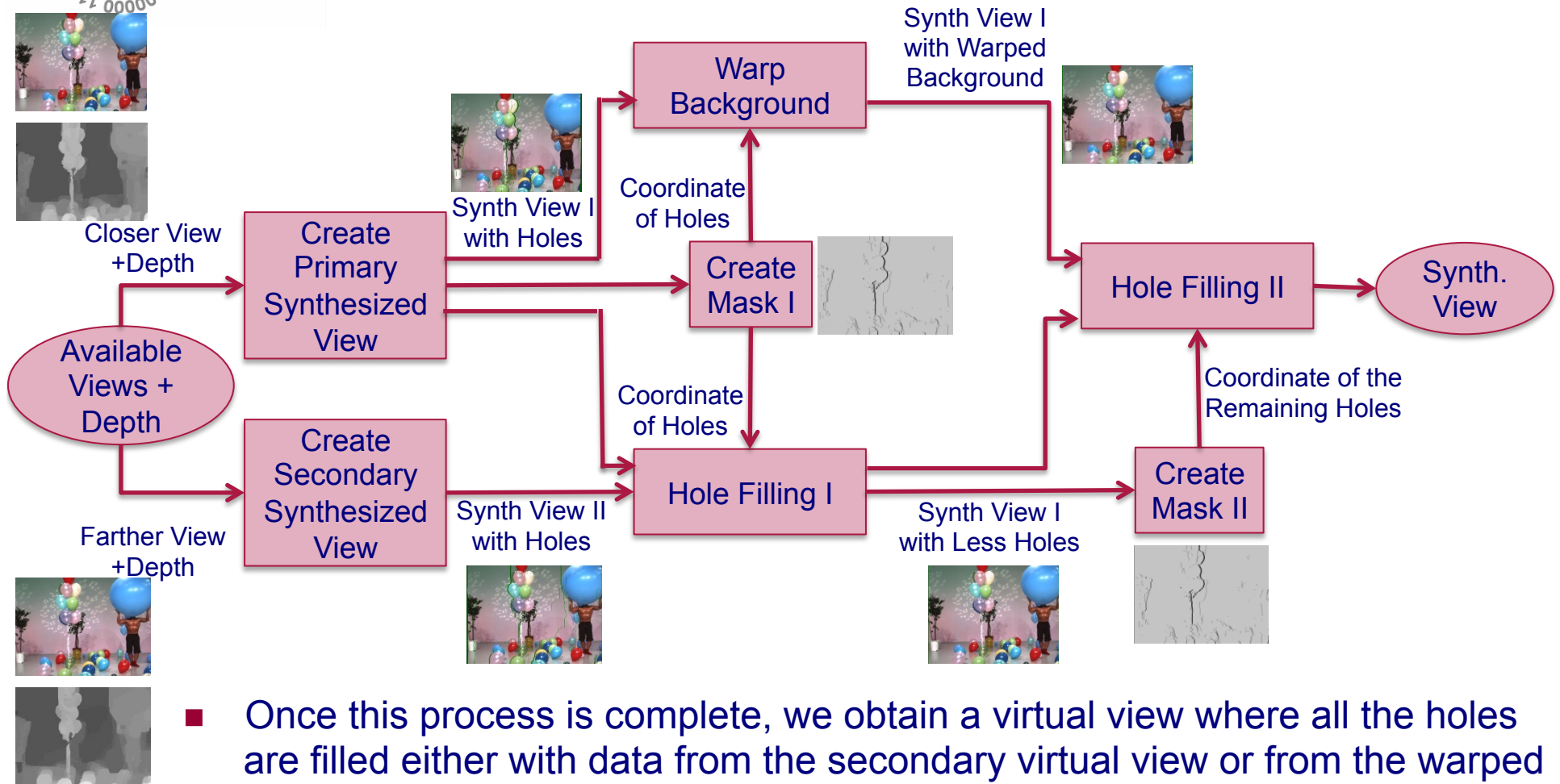
Our Proposed Interpolation Hybrid Approach







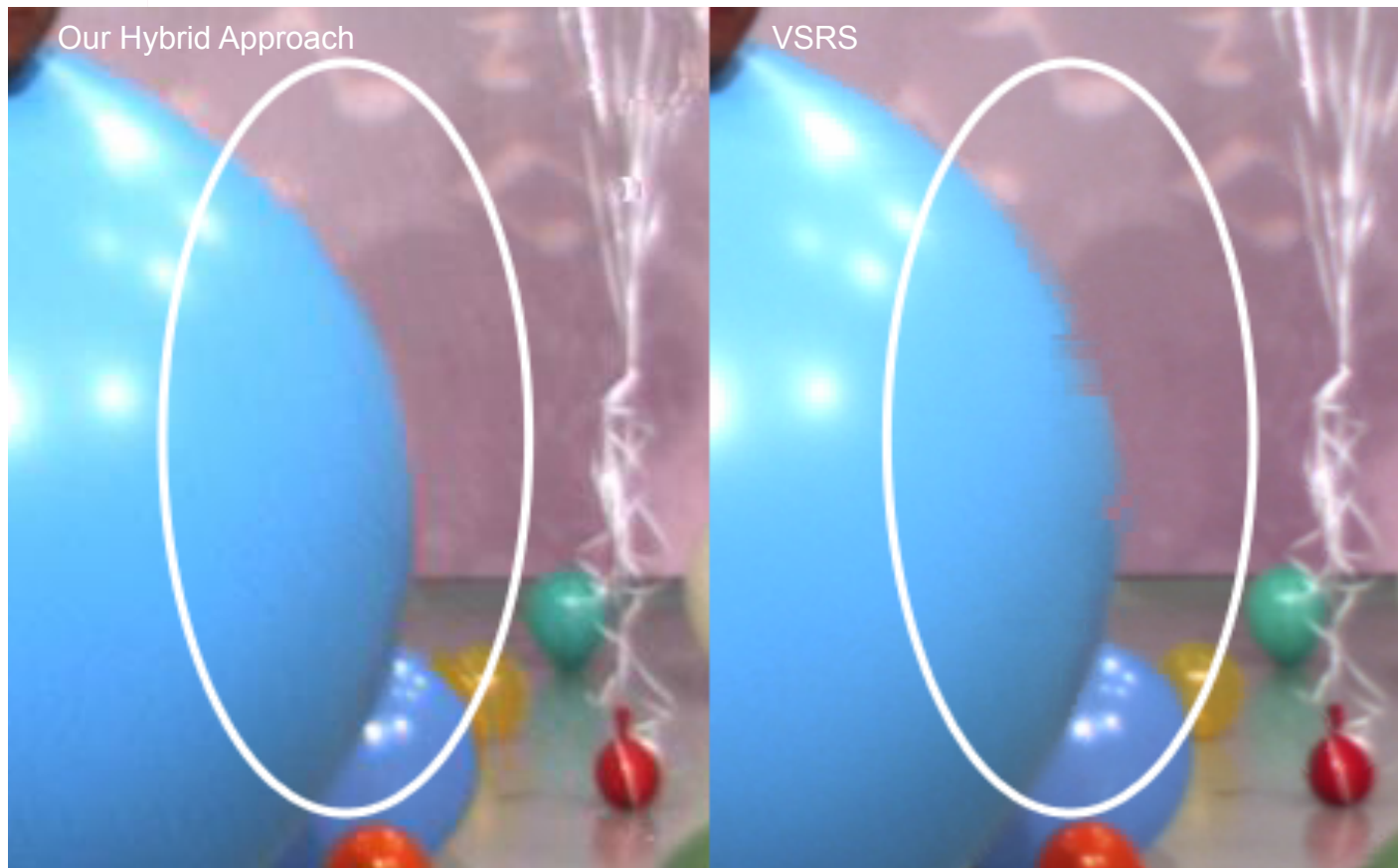
Our Proposed Interpolation Hybrid Approach



- Once this process is complete, we obtain a virtual view where all the holes are filled either with data from the secondary virtual view or from the warped image



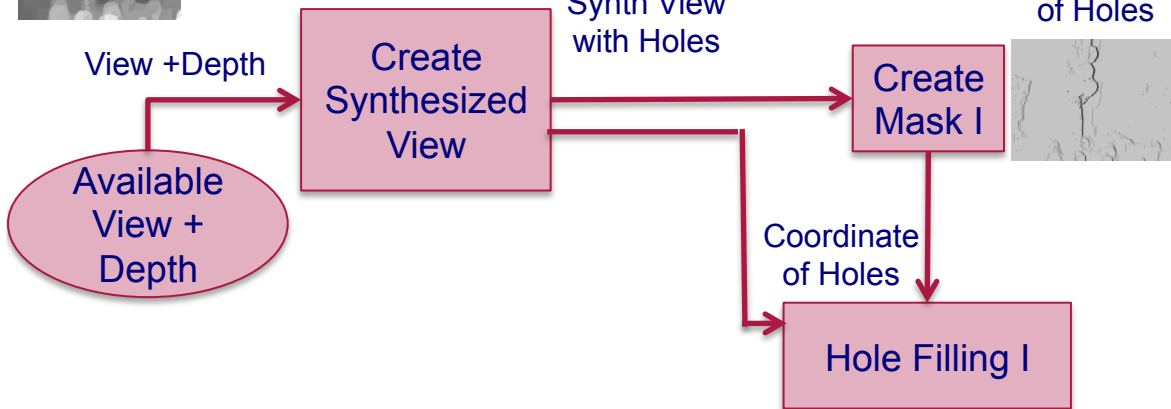
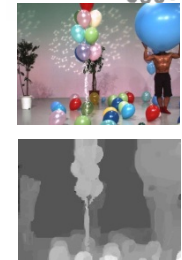
Visual Comparison with VSRS



A frame from our Hybrid Interpolation method shown on the left compared to the same frame generated by VSRS on the right



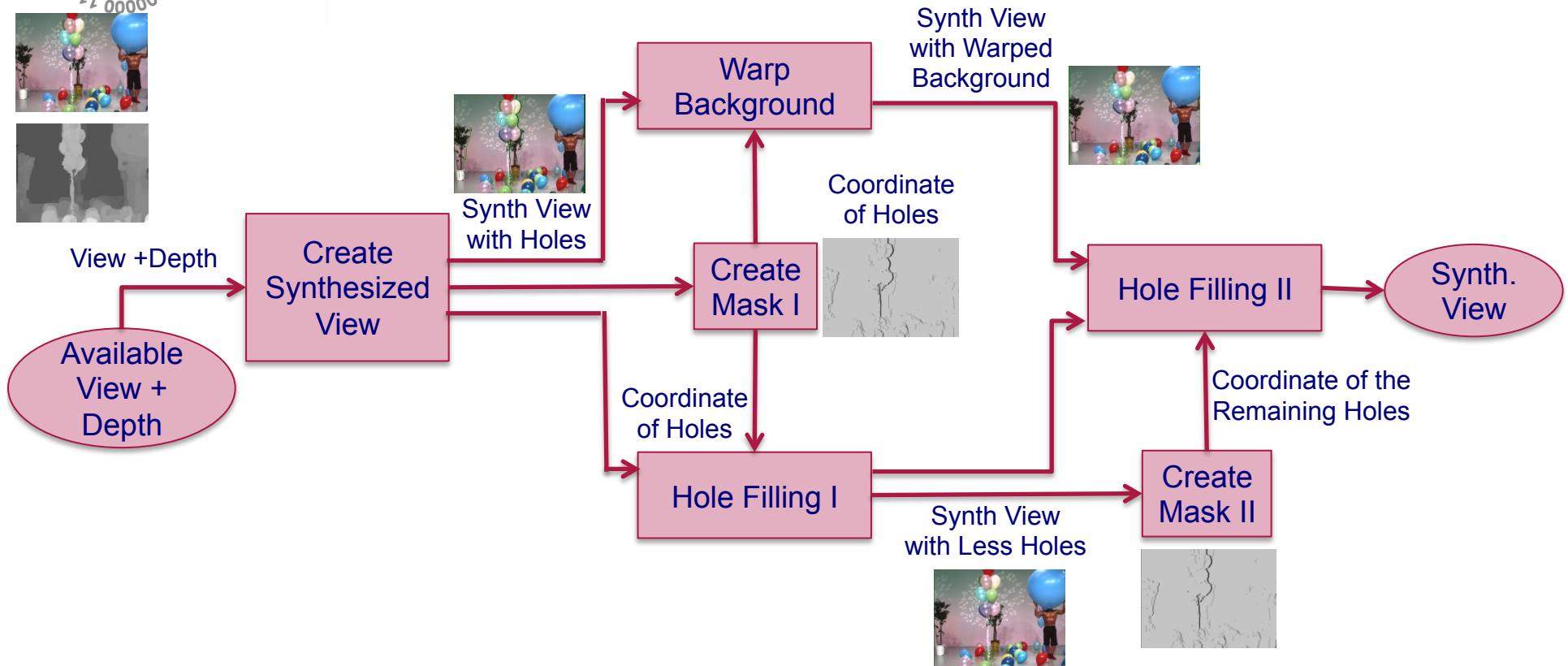
Our Proposed Hybrid Extrapolation Approach



- Holes smaller than a defined threshold (cracks) in the synthesized view are filled by inpainting using linear interpolation



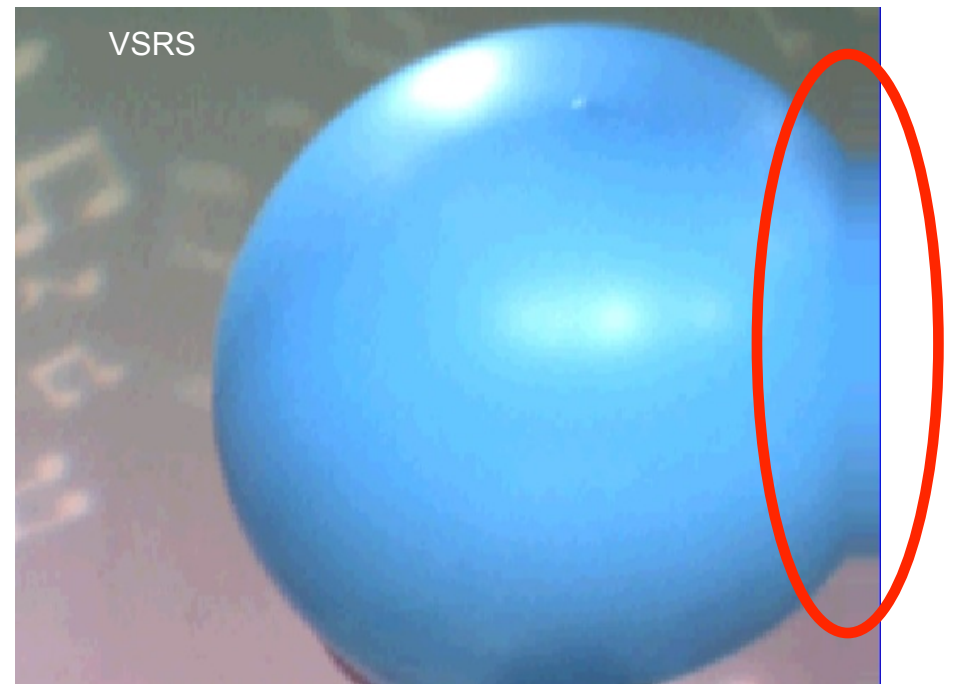
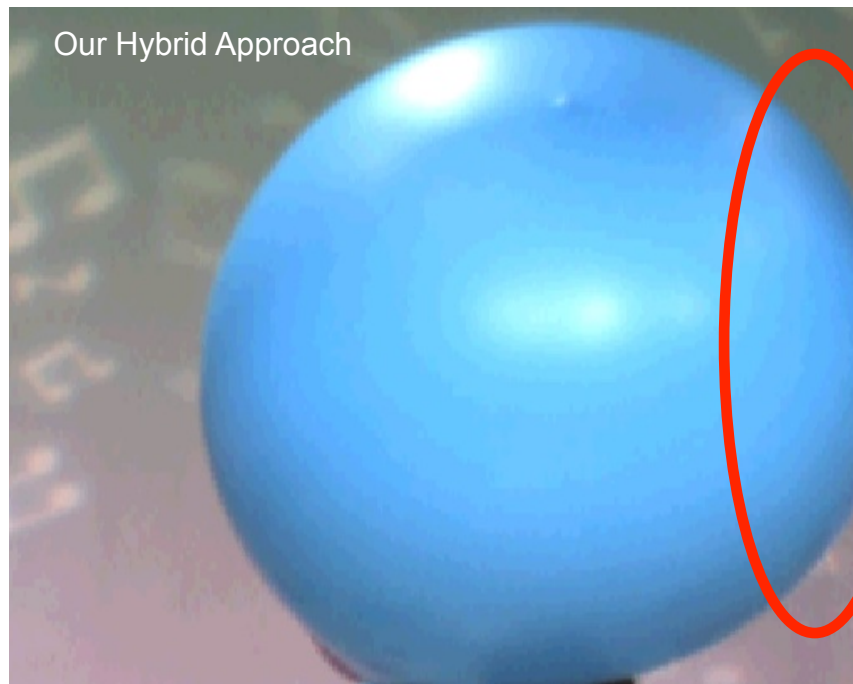
Our Proposed Hybrid Extrapolation Approach



- Once this process is complete, we obtain a virtual view where all the holes are filled either with linearly interpolated data or data from the warped image



Visual Comparison with VSRS



A cropped frame from our Hybrid method shown on the left compared to the same frame generated by VSRS on the right

Subjective Evaluation

- View Interpolation: 20 subjects (18 to 57 years old)
 - 13 left-eye dominant and 7 right-eye dominant subjects
- View Extrapolation: 18 subjects (21 to 28 years old)
 - 8 left-eye dominant and 10 right-eye dominant subjects
- 46" Full HD Hyundai 3D TV with passive glasses
 - brightness: 80, contrast: 80, color: 50, R: 70, G: 45, B: 30 (Recommendation by MPEG)



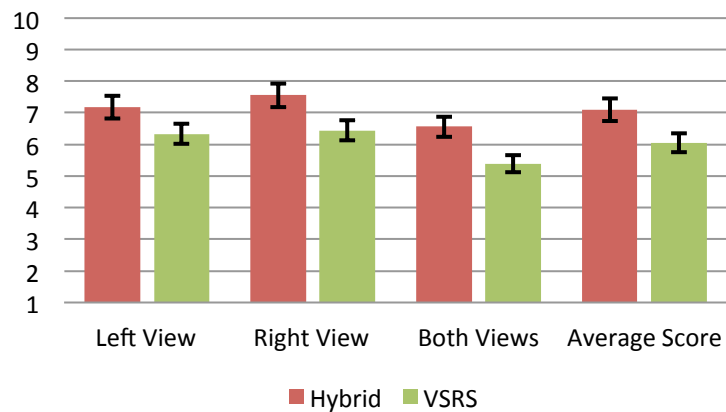
Subjective Test Setup

- Viewing conditions based on ITU-R Recommendations BT.500
- 3 Test Sequences:
 - “Balloons” (1024x768, 30fps, 300 frames),
 - “Kendo” (1024x768, 30fps, 300 frames)
 - “GT_Fly” (1920x1088, 25fps, 250 frames).
- Test Scenarios:
 - Only right view is synthesized
 - Only left view is synthesized
 - Both views are synthesized
- Subjects were asked to rate a combination of “naturalness”, “depth impression” and “comfort” (1-10 score)
- For our view interpolation tests there were 2 outliers which were removed from the result set
- There were no outliers for the view extrapolation tests

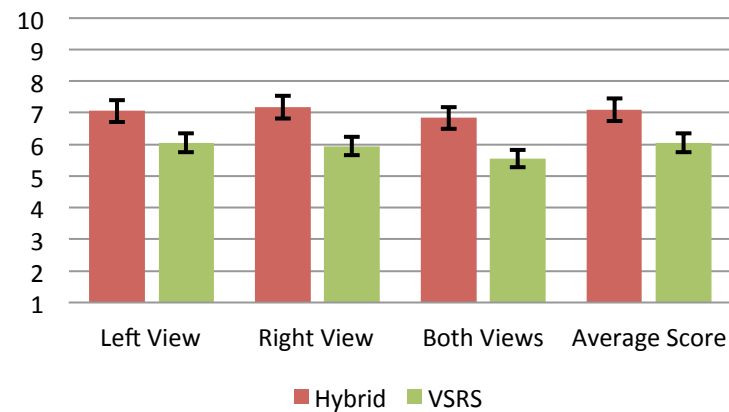


Interpolation Results

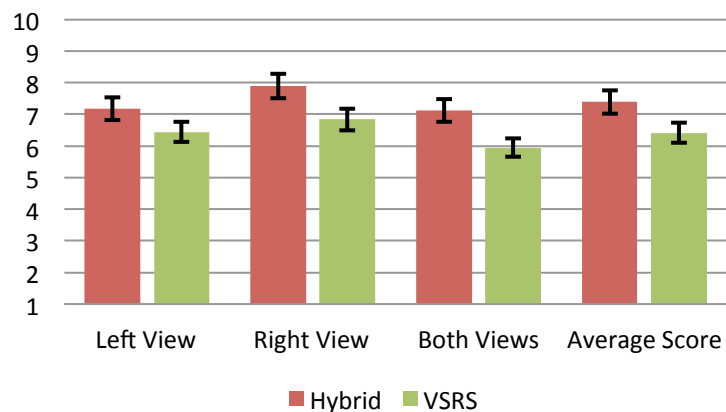
Balloons Synthesized Views



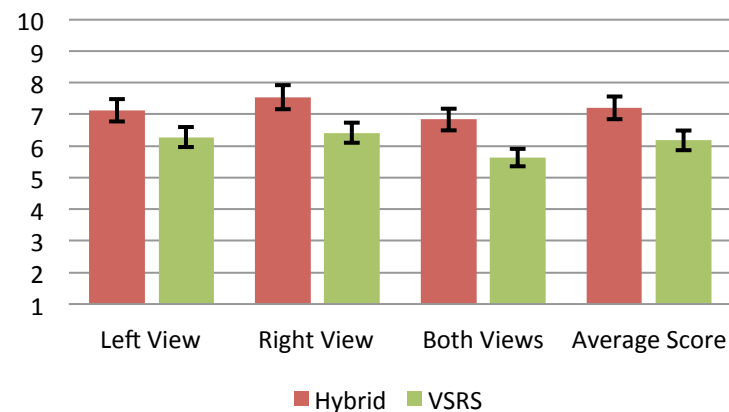
Kendo Synthesized Views



GT_Fly Synthesized Views

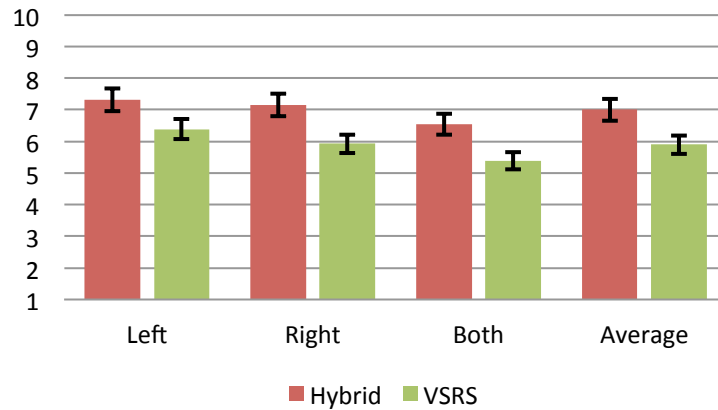


Averages for Synthesized Views

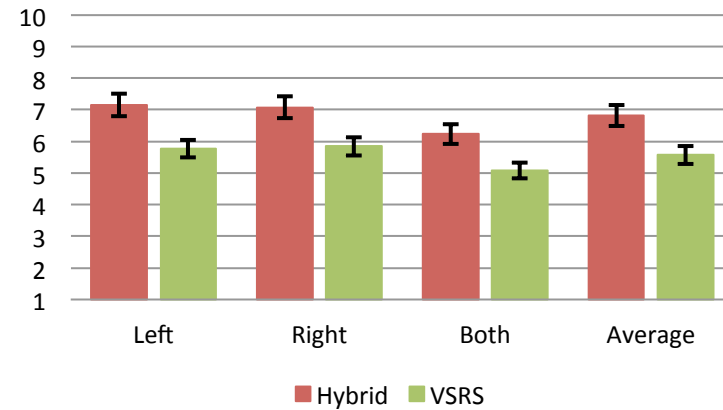


Extrapolation Results

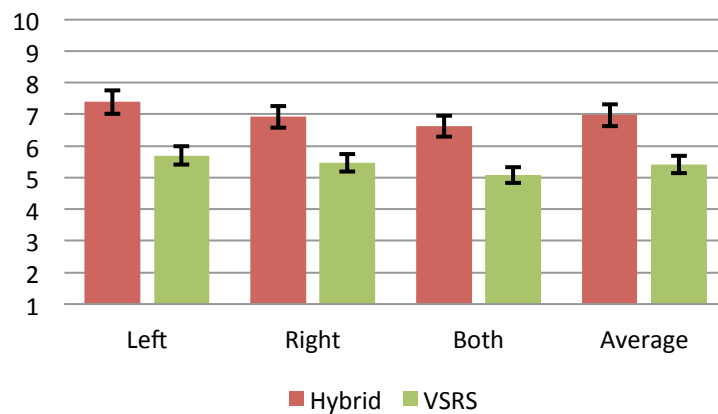
Balloons Synthesized Views



Kendo Synthesized Views



GT_Fly Synthesized Views



Averages for Synthesized Views

