

3D Measurement of Ball Trajectory using Motion Blur by Asynchronous Video Cameras

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ABSTRACT

AIM To measure continuous 3D Trajectory of ball using ordinary video cameras.

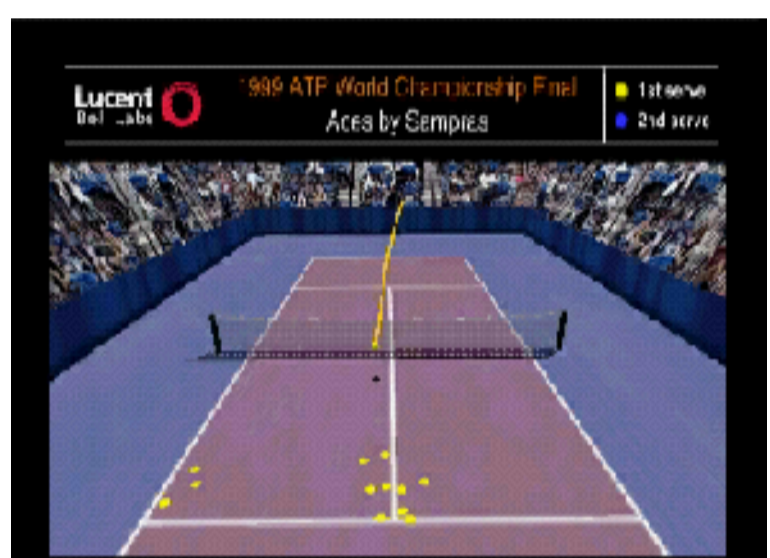
METHOD Recording a motion blur of ball intentionally, and measuring 3D trajectory of ball using the motion blur.

FEATURES Our proposed method has these features.

- possible to measure continuous trajectory
- not require synchronous between video cameras

BACKGROUND

Measurement of 3D ball trajectory using video cameras has been used in television broadcast.



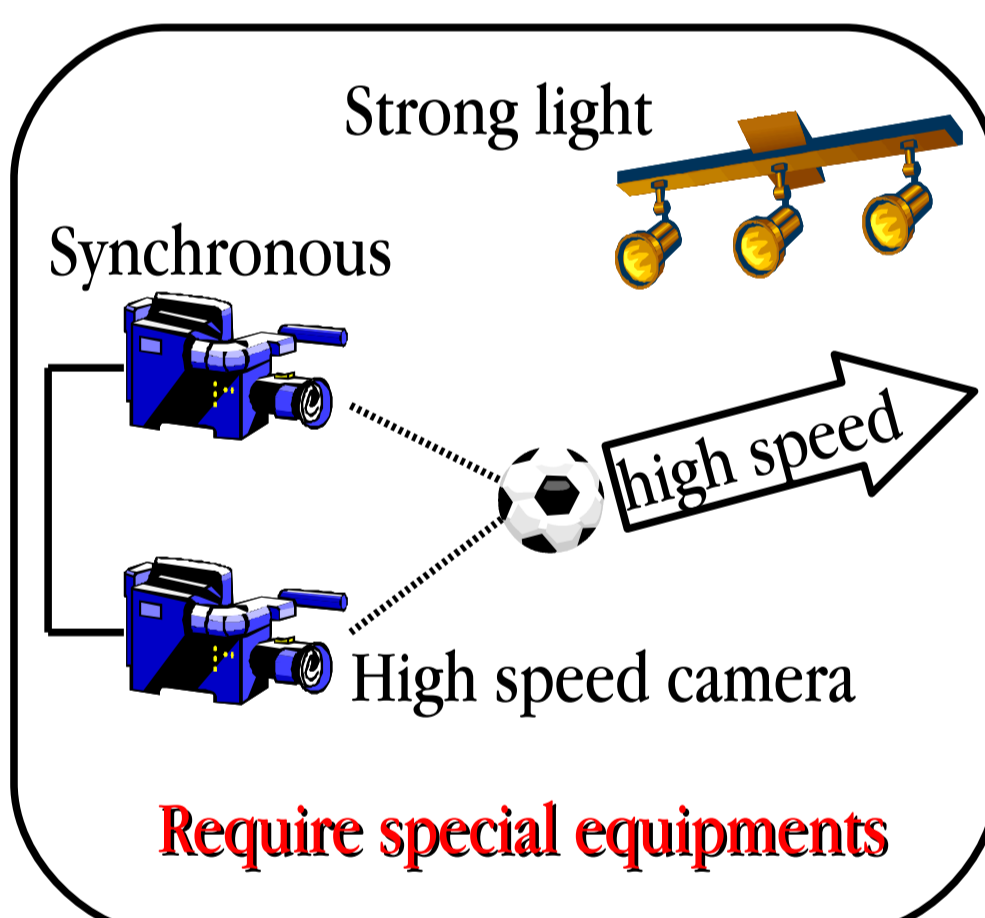
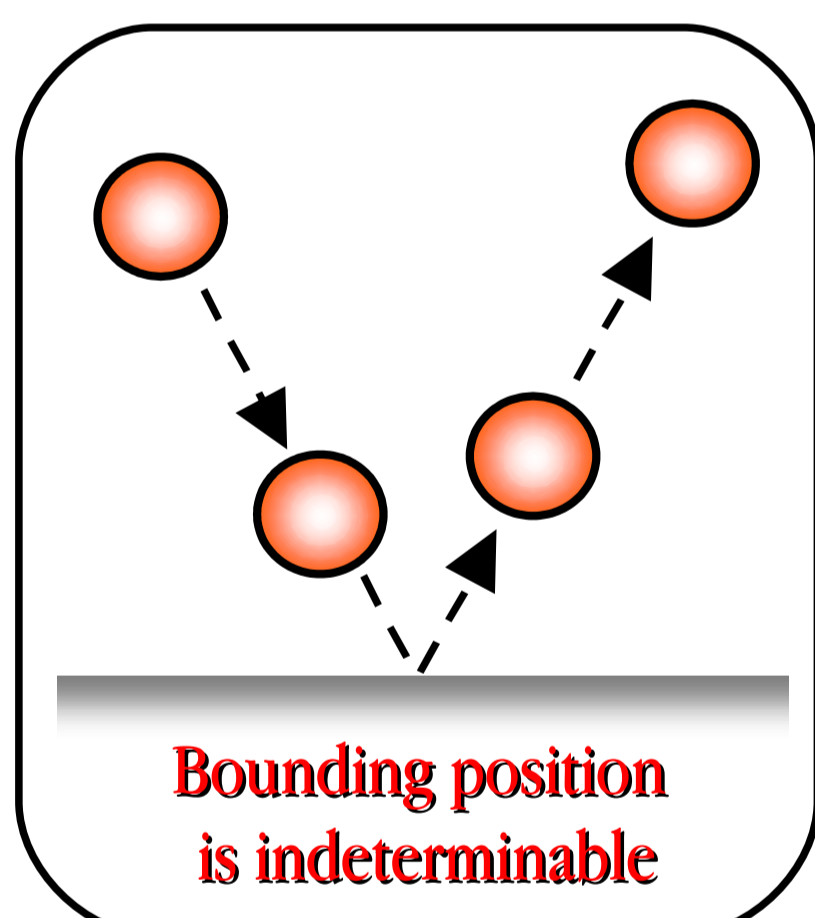
Lucent Vision™ [1]
(for tennis broadcast)



PitchTrax™ [2]
(for baseball broadcast)

In general, we can estimate 3D ball position using stereo method. However, stereo method has some problems.

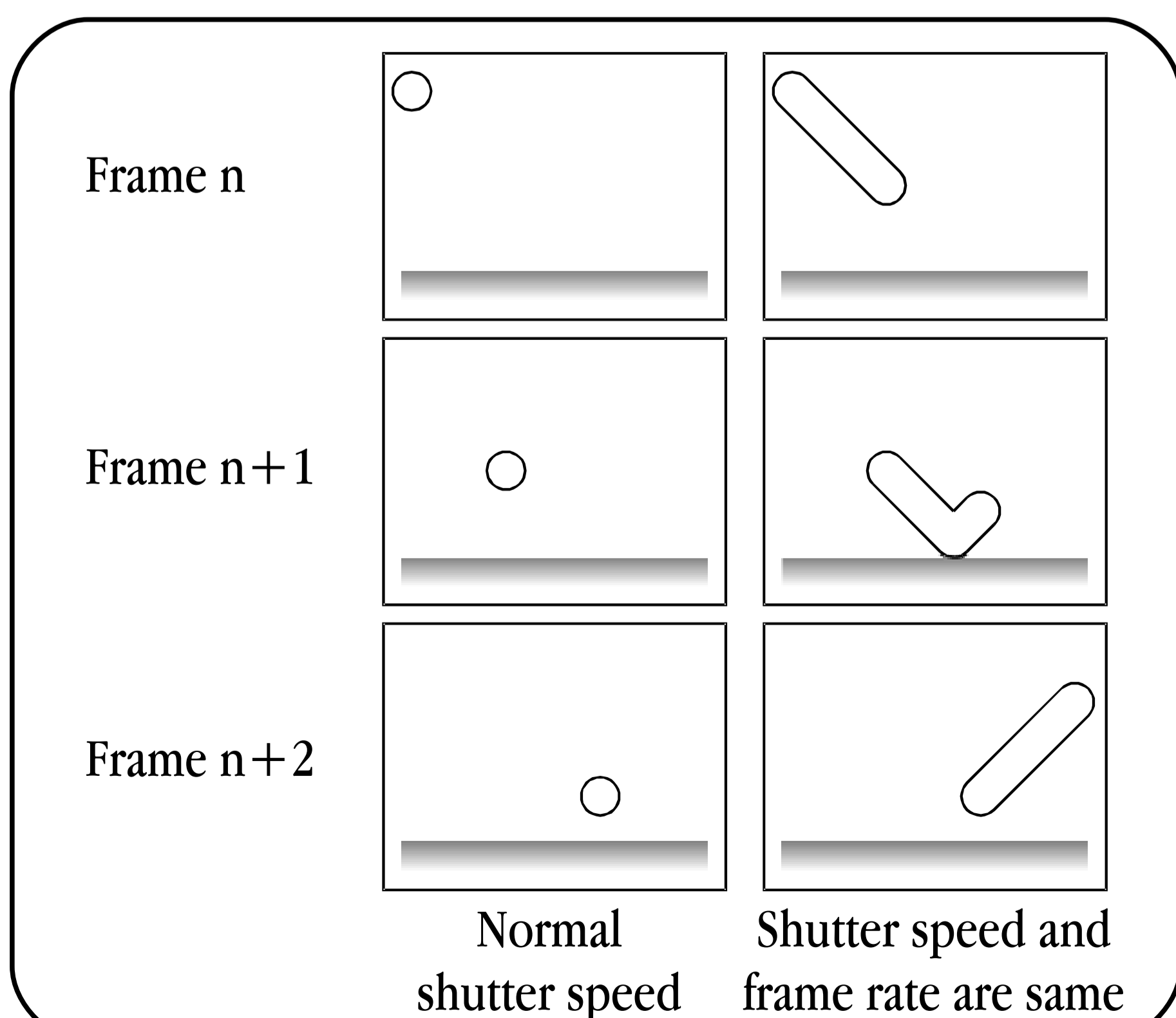
- impossible to measure ball pathway between shutter timings.
- require synchronous between video cameras.



Solving these problems can be applied to judgment of ball sports which require to measure accurate ball trajectory and support system of ball sports for the public which require to be inexpensive.

APPROACH

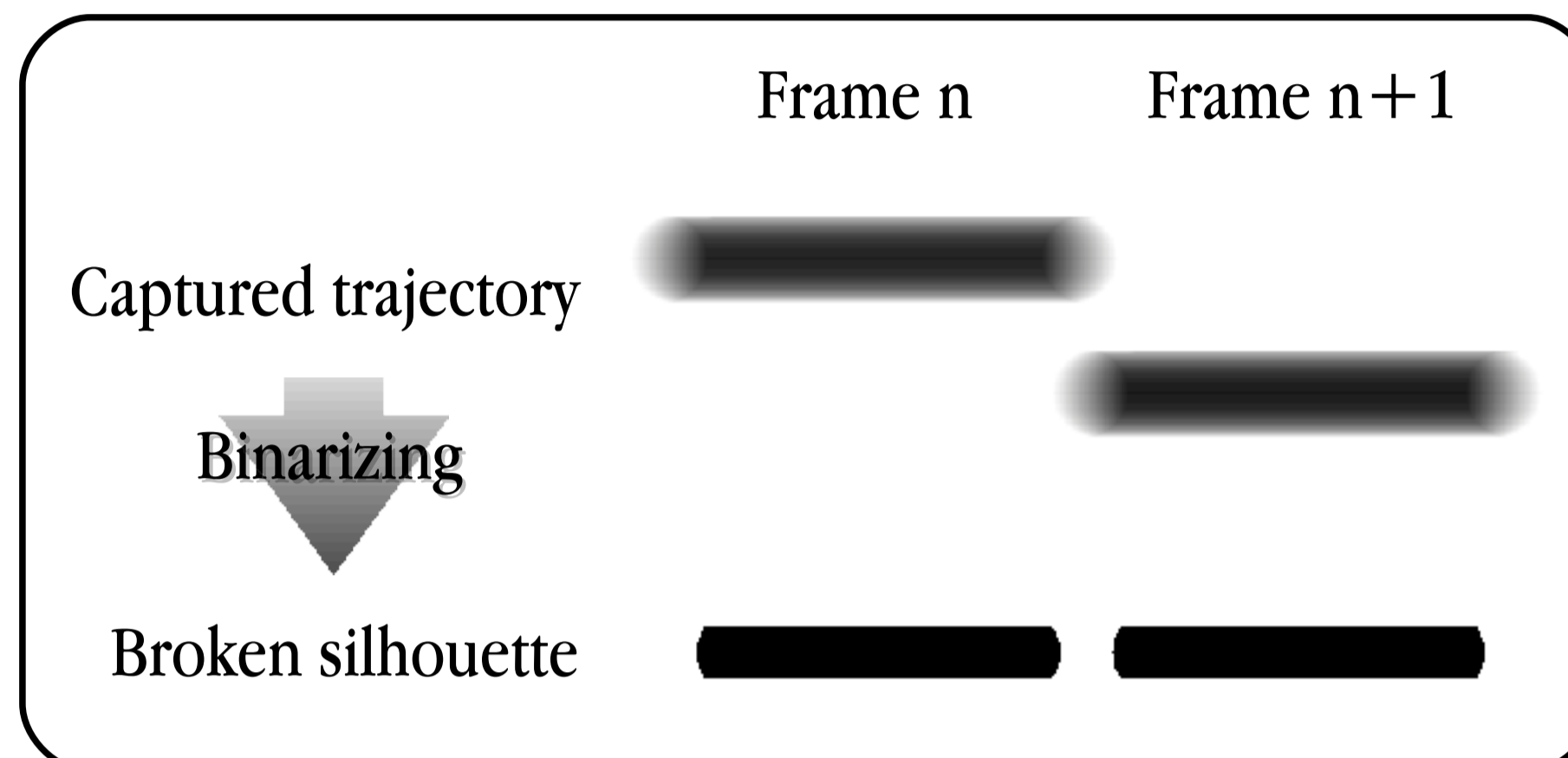
- Setting video cameras around ball moving area.
- Setting shutter speed to frame rates. (e.g. Frame rate: 30fps, Shutter speed: 1/30sec)



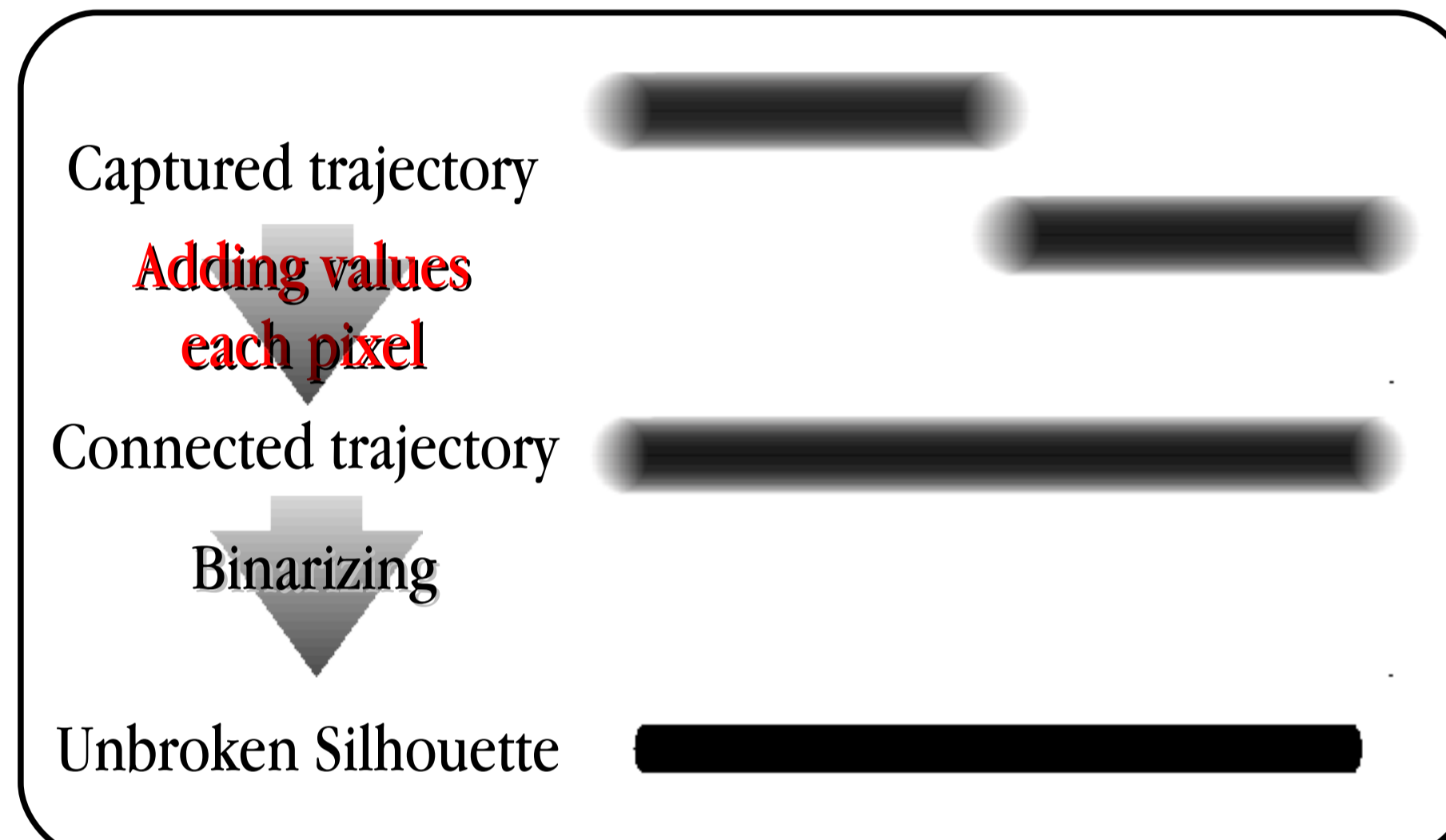
- Reconstructing 3D trajectory using Shape from silhouette method[3].

IMPLEMENTATION

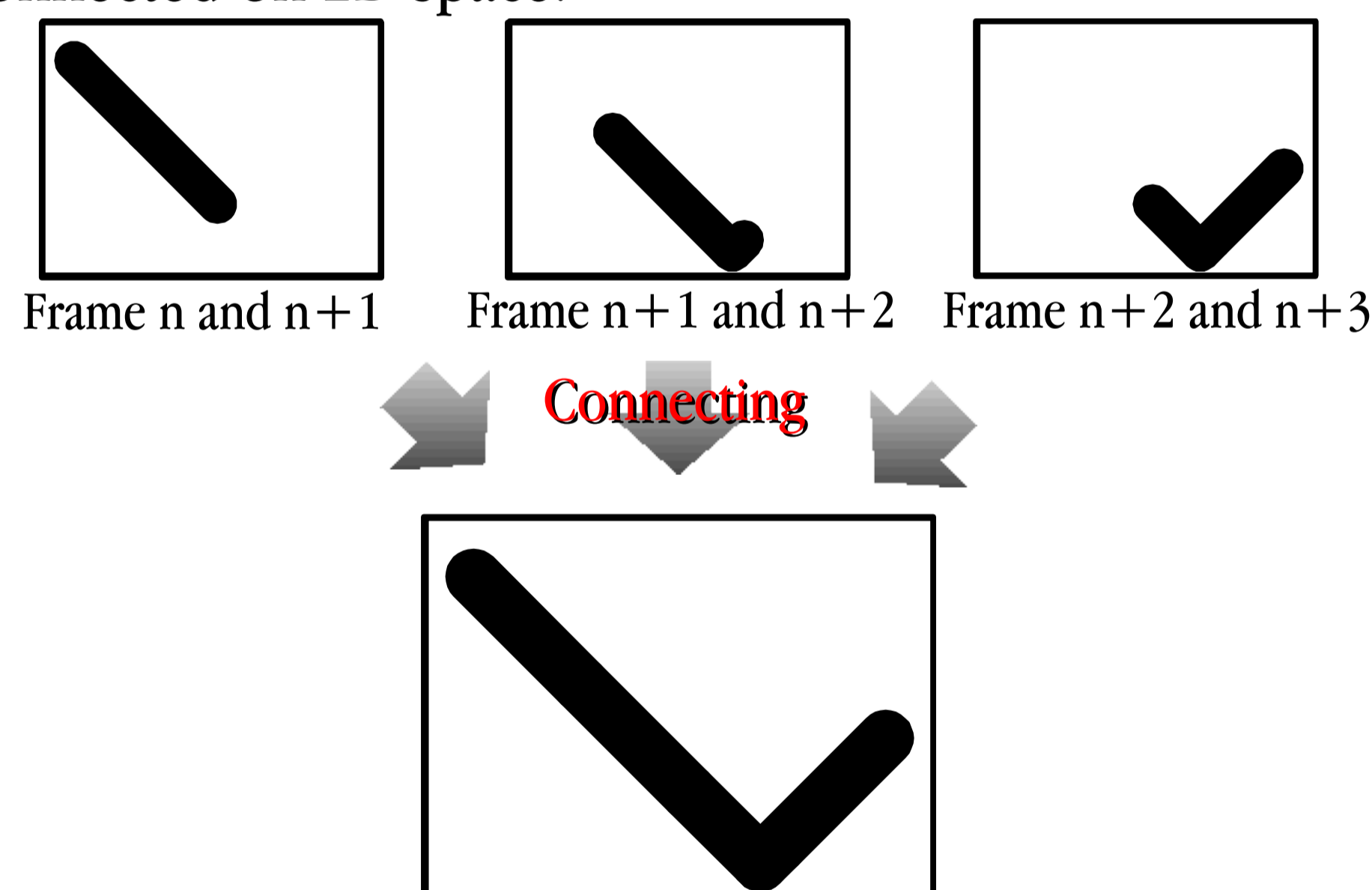
The captured trajectory is dilute on a its periphery than a center. Hence, a silhouette is slightly smaller than real ball size when we binarize images to make silhouette. The silhouettes may not overlap.



To solve this problem, we added pixel values of n and n+1 frame before binarization process.

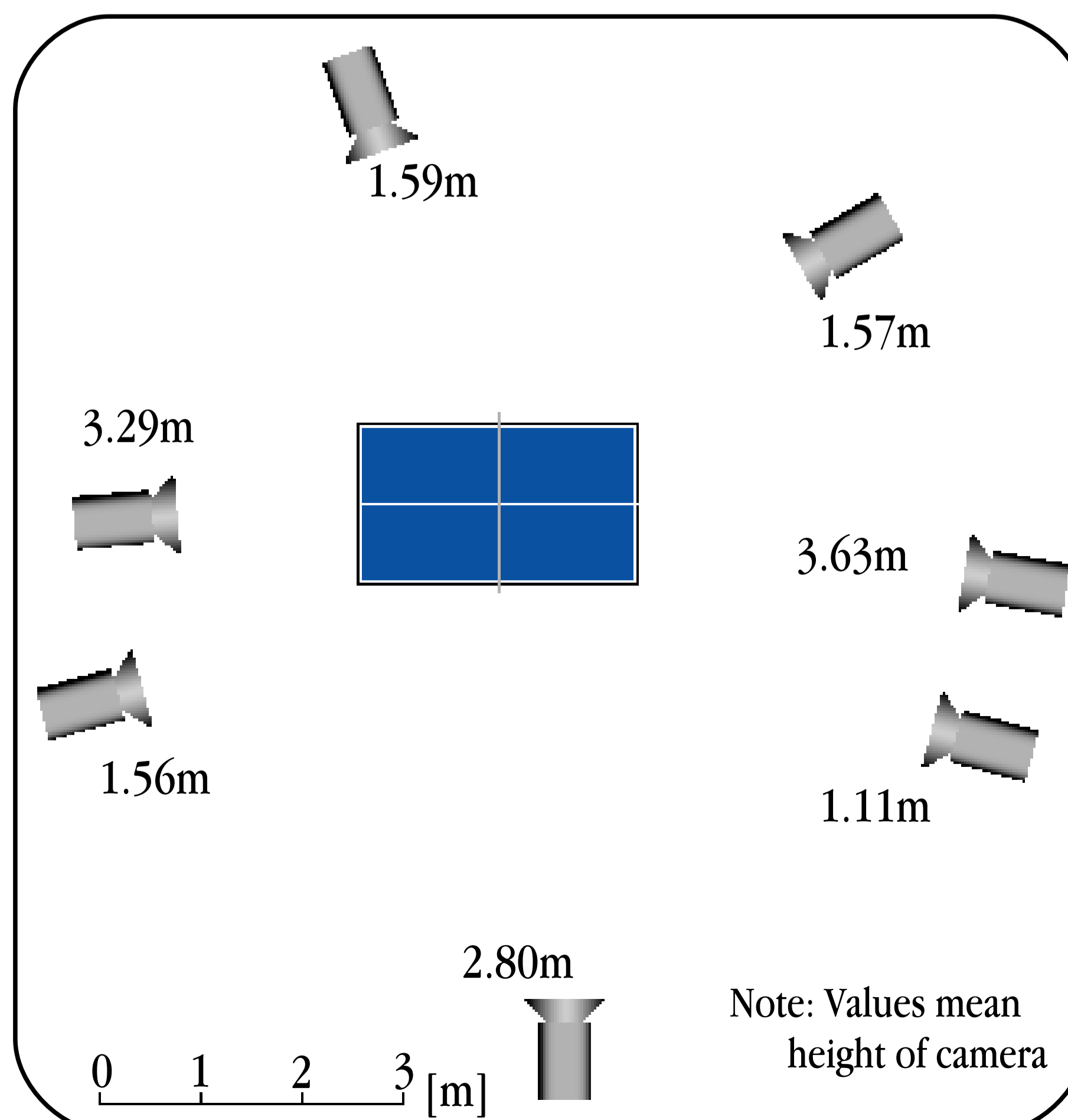


The silhouettes for Shape from silhouette method are connected on 2D space.

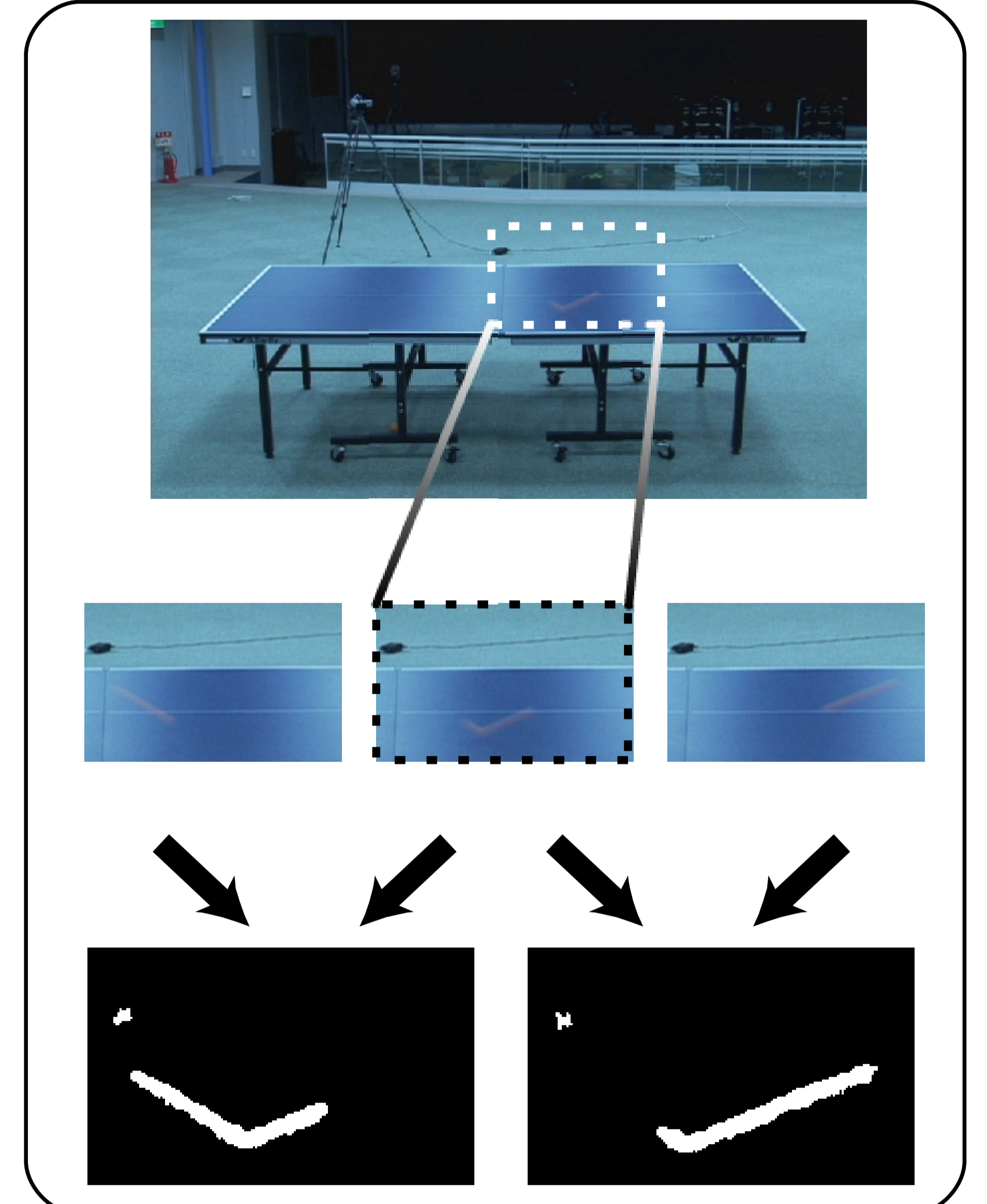


EXPERIMENT – Setup –

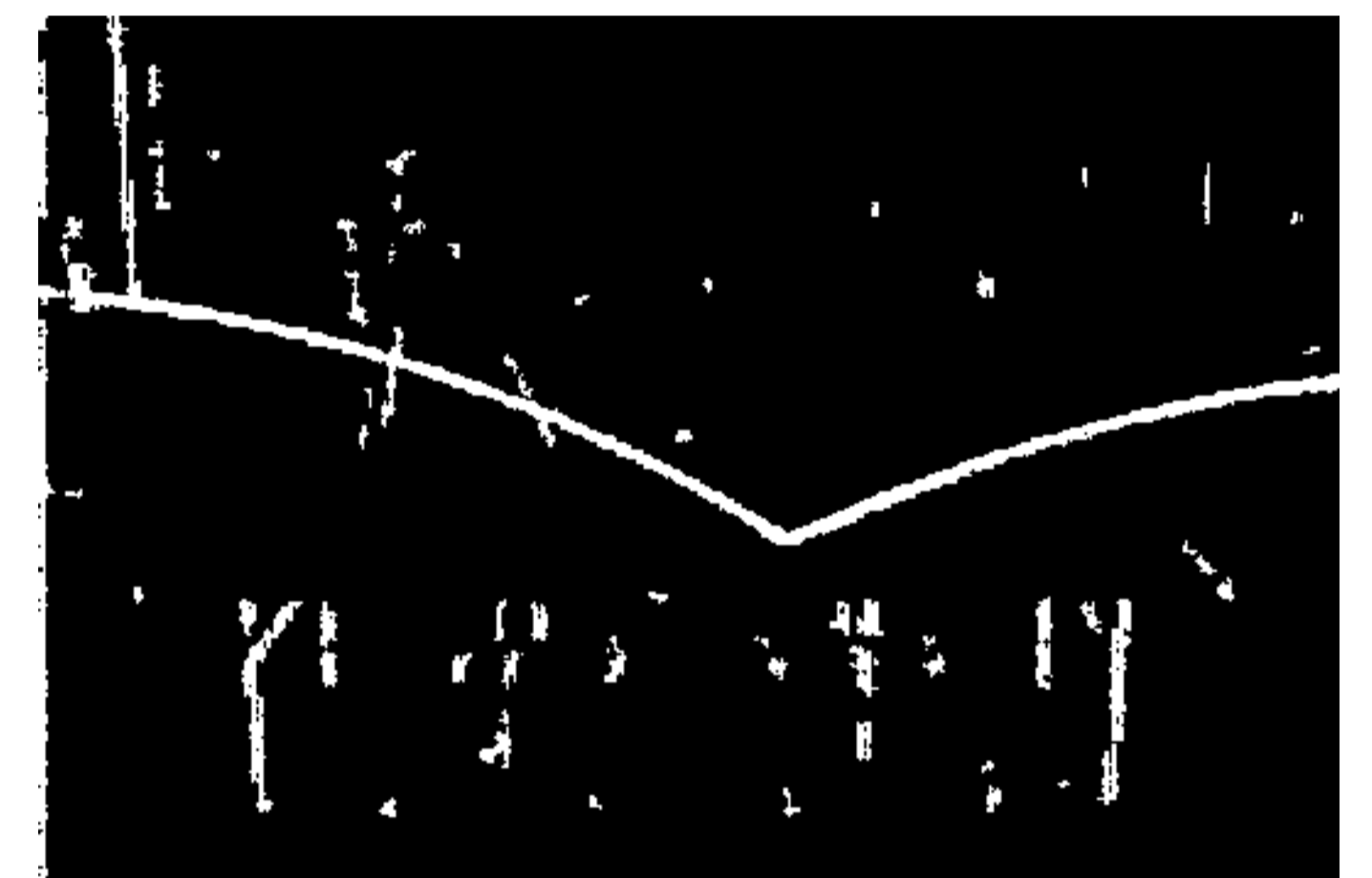
We test the feasibility of our method in a real sport (table tennis) environment. All of the video cameras are Sony Handycam. The shutter speed is set to 1/30 sec, and the frame rate is 30 fps. A size of the captured image is DV (720 x 480 pixels).



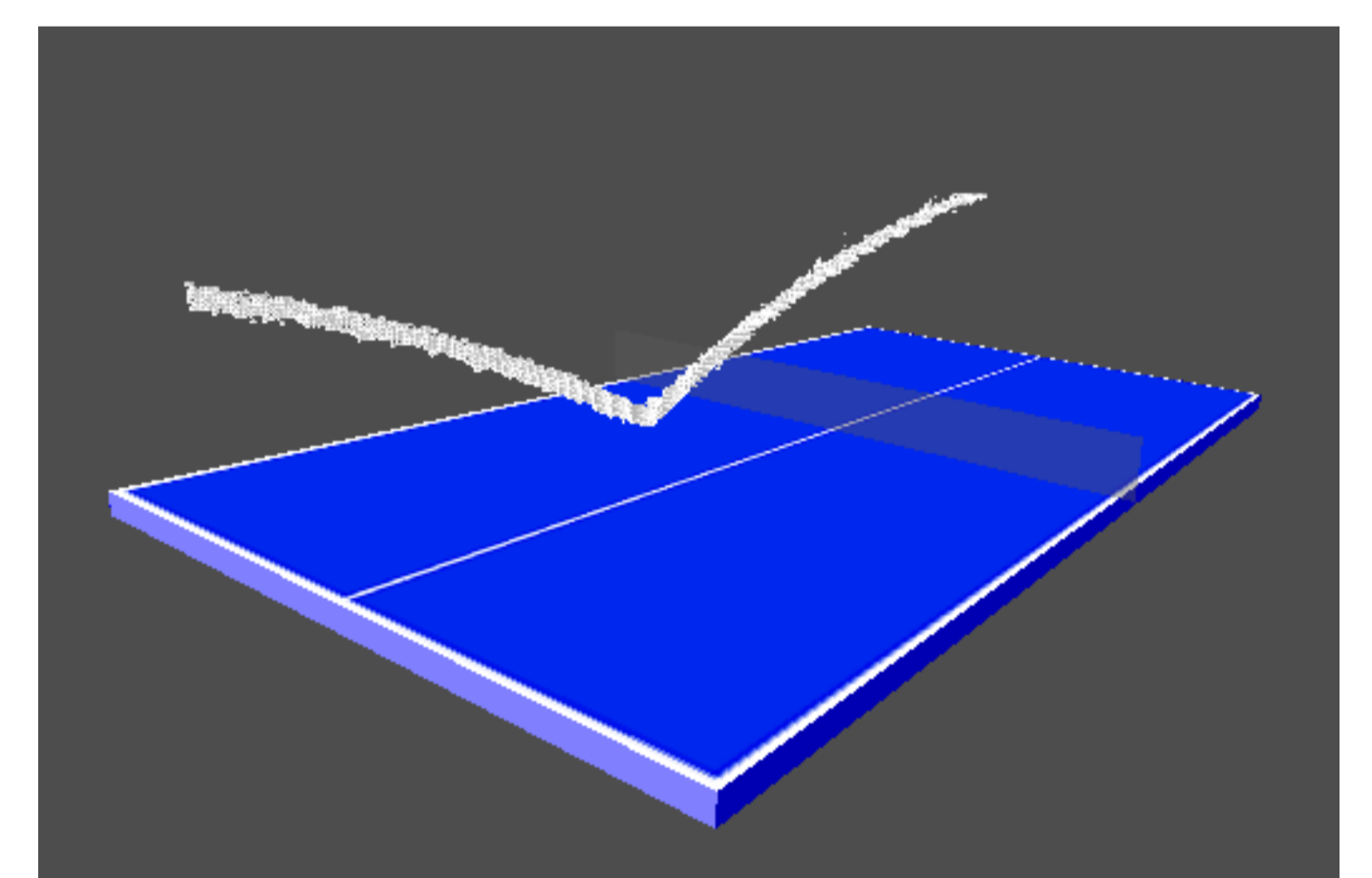
EXPERIMENT – Result –



Captured image and silhouette



Connected silhouette



Reconstructed 3D trajectory using Shape from silhouette

CONCLUSION

Our proposed method can measure a continuous 3D trajectory of ball without synchronous and high speed video cameras. The experimental result shows availableness of our method in real table tennis environment.

REFERENCES

- [1]Gopal S. Pingali et al., "Real Time Tracking for Enhanced Tennis Broadcasts", Proc. of IEEE CVPR, pp.260-265, 1998.
- [2]QuesTec, Inc., PitchTrax™, http://www.questex.com/q2001/prod_pt.html
- [3]Takashi Matsuyama et al., "Generation, Editing, and Visualization of 3D Video", Trans. of Virtual Reality Society of Japan, Vol. 7, No. 4, pp. 521-532, 2002.