An AARO Information Paper

Effect of Forced Perspective and Parallax View on UAP Observations

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Introduction

While no single explanation or method of analysis can account for all unidentified anomalous phenomena (UAP) cases received by the All-domain Anomaly Resolution Office (AARO), the effects of forced perspective and parallax can frequently explain excessively large sizes or high speeds described in UAP reports. In many cases, the reporter may be positioned far from the object being observed while moving fast relative to it. Under these conditions, an observer can misinterpret the apparent size and speed of a UAP due to the two separate but related phenomena of forced perspective and parallax. This paper provides a basic overview of these phenomena and their impact on UAP observations.

Forced Perspective and Range Estimation

Figure 1: *Example of forced perspective. The person in the foreground is much closer to the camera than the tower.*

Forced perspective is used in photography and filmmaking to give the illusion that an object is larger or smaller than its true size. Posing for a photograph while holding the Eiffel Tower by the tip or pushing against the Leaning Tower of Pisa is a classic example of this technique, as depicted in Figure 1. The Leaning Tower of Pisa is approximately 190 feet tall, and an average person is between five and six feet tall. In this example, forced perspective distorts the distance between the tower and the person, causing both the person to appear larger and the tower to appear smaller than their true sizes.

The example above demonstrates the effects of forced perspective. Recognizing the optical illusion in this case is easy because the actual sizes of both objects in the image are known. However, judging the sizes of unknown objects in the sky is harder. Observers will often compare unknown objects to clouds, trees, buildings, or other non-standard references to make estimates. Observers can, therefore, inaccurately perceive the distance between an object and a reference, leading to an inaccurate estimate of the object's actual size. Making an error while estimating an object's size or distance is even more likely if, unlike the Tower of Pisa, the object has no discernable features (e.g., windows, propellers, wings).

Consider a case in which there are no references against which to compare an unknown object. In such a case, an observer must estimate its distance without any clues. Accurately estimating an object's size and distance without a known reference is difficult. Forced perspective can cause large, faraway objects to appear smaller and closer than their actual size and position - or vice versa. The image in Figure 2 demonstrates this effect. A 10' sphere with no features (e.g., windows, lines, surface details) positioned at an unknown distance from an observer may appear smaller or larger than its actual size, depending on the observer's reference point and assumptions.

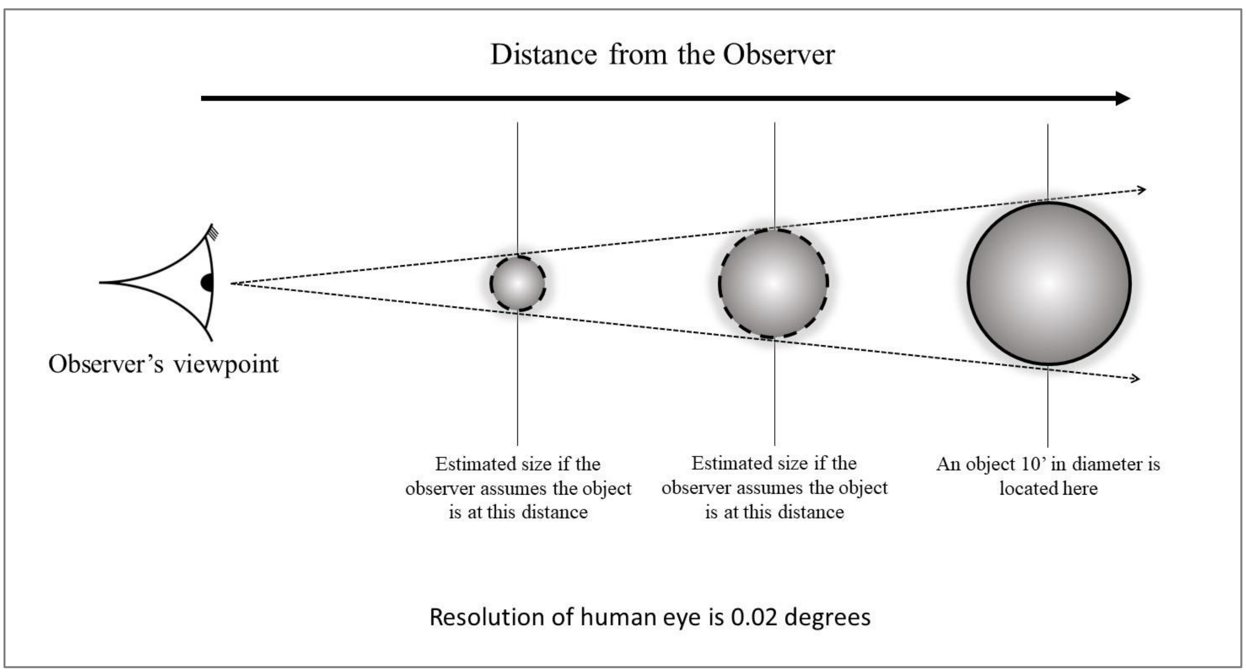

Figure 2: *The 10' sphere on the far right is an unknown distance from the observer. If the observer estimates the range to be shorter, they will estimate the size to be smaller.*

Parallax

Parallax view, or the parallax effect, is a phenomenon that can distort an object's actual position when viewed against a background from different angles. A simple demonstration of the parallax effect is to hold a thumb out at arm's length and close one eye. Note the location of your thumb relative to an object in the background. Now, without moving your thumb, close the first eye and open your other eye. Again, note the position of the thumb relative to the background. Though your thumb did not move, it appears to have changed locations due to the distance between your eyes. Moving your thumb closer to your eyes and repeating the process gives the impression that the thumb moved further relative to the background. Your thumb appears to move because each eye provides a different parallax view.

Another way to experience multiple parallax views of a stationary object is for the observer to be in motion. As the observer moves, the parallax view changes. This change in perspective can cause a stationary object to appear to be in motion. The faster the observer moves, the more dramatic this effect can be. Electronic sensors can also be susceptible to these effects. Unlike in the thumb example, when an electronic sensor on an airborne platform moves relative to an object, it can be too far away to estimate an exact range, leading to misinterpretation of true size and speed.

Consider the example shown in Figure 3. An observer in an airborne platform moves over the earth's surface which features a river running through the surrounding area. A stationary object is suspended directly above the river. As the airborne observer moves from position 1 to 2 to 3 in the air, they view the object from different angles. Parallax effects cause the object to be "projected" against three different points in the background. From position one, the object appears projected against the right bank of the river, from position two against the river[1], and from position three against the left bank of the river. This projection illusion creates a perception of motion as the object appears to move across the river in the opposite direction of the observer. The faster the airborne sensor moves, the higher the perceived speed of the object. Because of parallax, stationary objects can appear to have motion, and slow-moving objects can appear to move very fast.

[1] The parallax angle is zero if the observer is directly above the object. This allows the observer to perceive the object's location against the background accurately.

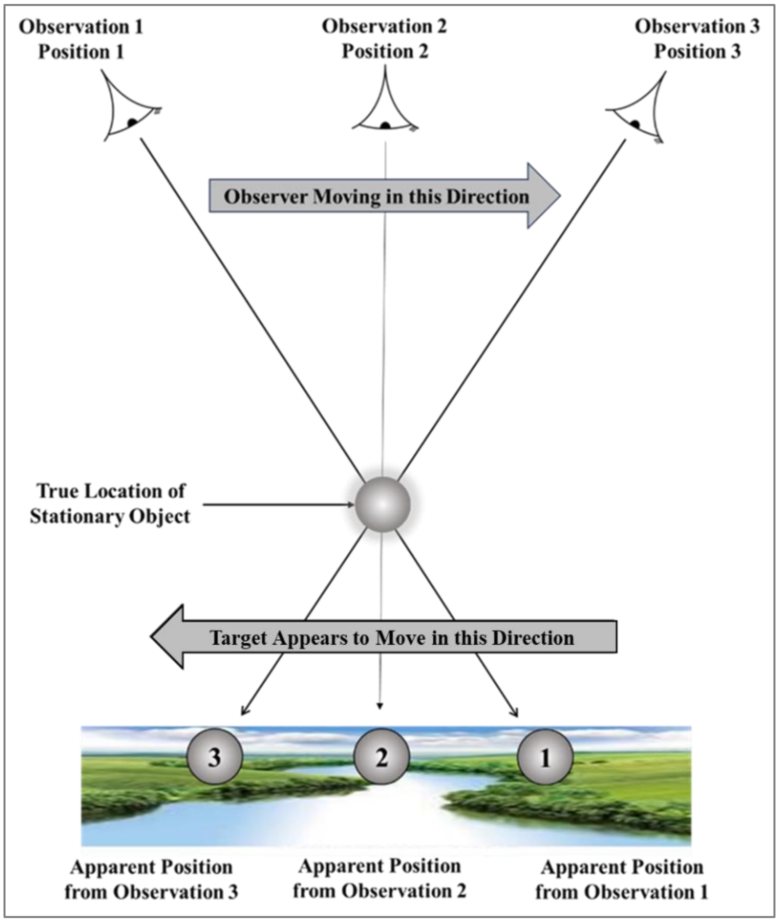

Figure 3: *Parallax causes the position of an object to be projected at different points against a background. As the observer moves, the changes in background projections cause the object to have an apparent motion.*

Summary

Not all reports of fast-moving UAP are attributable to the effects of forced perspective or parallax. However, in some cases, the effects of these phenomena are known to cause inaccurate estimations of a UAP's size, speed, and direction of travel. These phenomena consequently affect data derived from a single sensor moving very fast relative to the target object. Despite this susceptibility, single-observer reports are critical to consider in AARO analyses. These reports can supplement additional sensor data to help create a more holistic picture of an object's size and speed. Observers submitting a UAP report should still estimate range, size, and speed as part of a complete description of their observation. Observers with a more robust understanding of forced perspective and parallax are better equipped to assess a UAP's characteristics and provide more context to these details in their reporting.