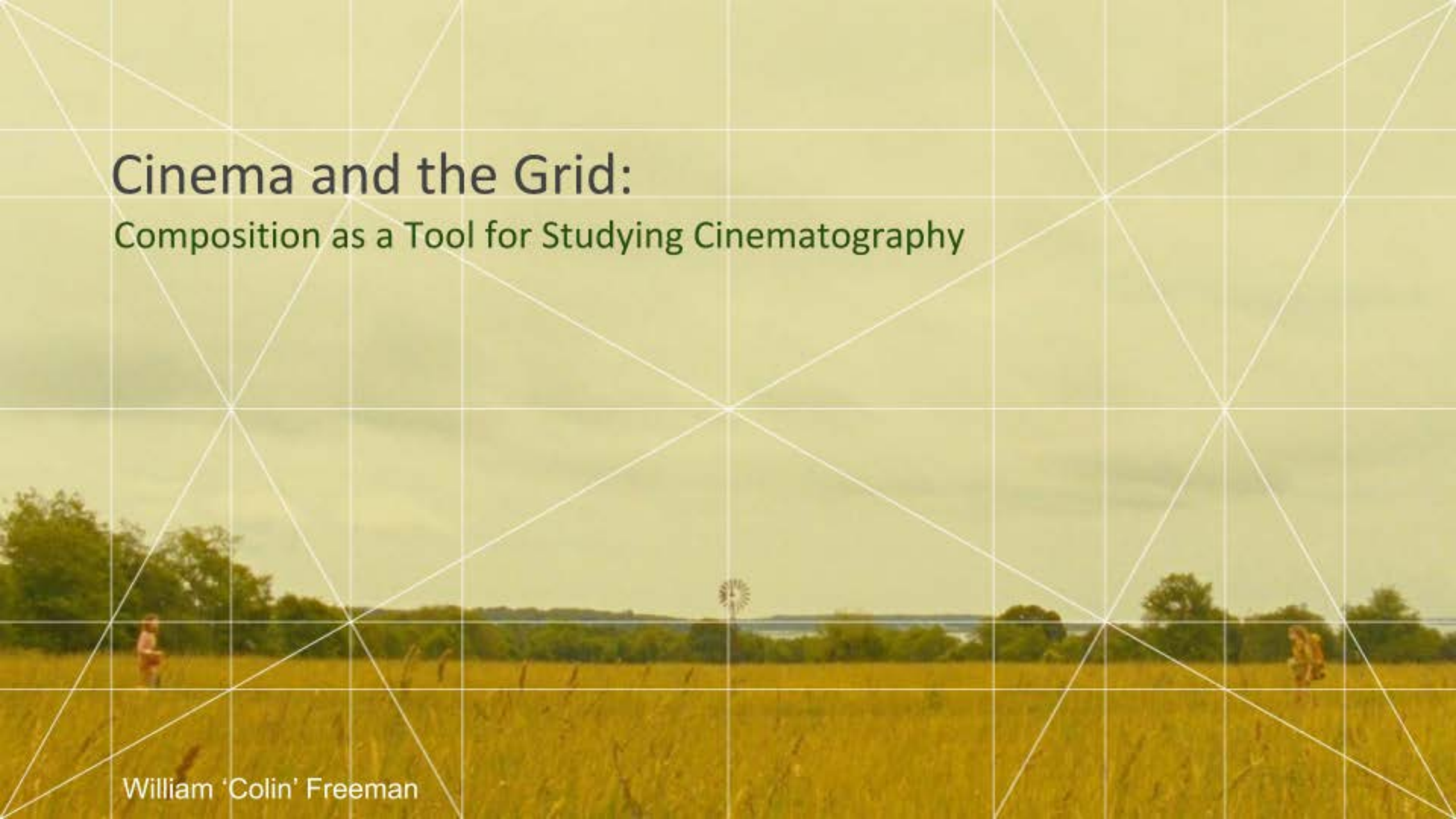
Cinema and the Grid:

Composition as a Tool for Studying Cinematography



William ‘Colin’ Freeman

Introduction

Geometry and Proportion have been an important contributor to aesthetic principles for thousands of years.

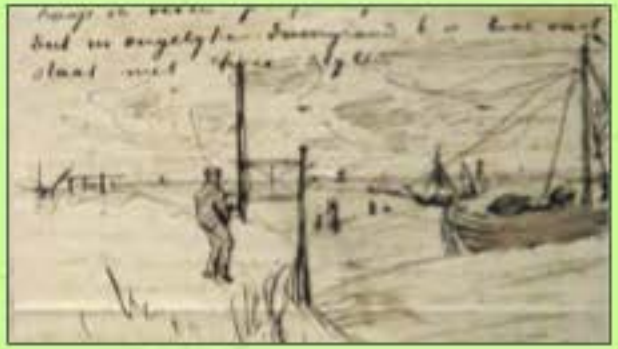
Before the Renaissance the contributions happened mainly in music, architecture and sculpture.

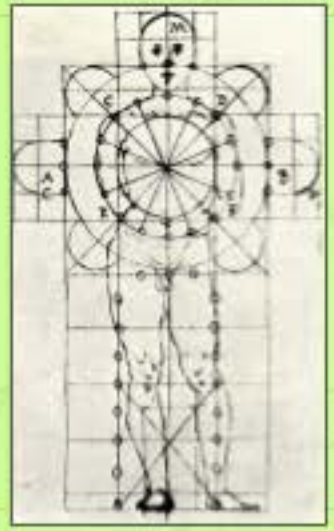
Introduction

Between the 18th and 19th centuries, the concepts of **‘divine geometry’** and **scientific reductionism** took root and grew, influencing the fields of art, biology, astronomy, math and psychology.

‘Golden numberism’ in particular, introduced by Adolf Ziesing in 1855, had an enormous but underestimated impact on Art and Media in the twentieth century.

Grid History: the seeing composition tool

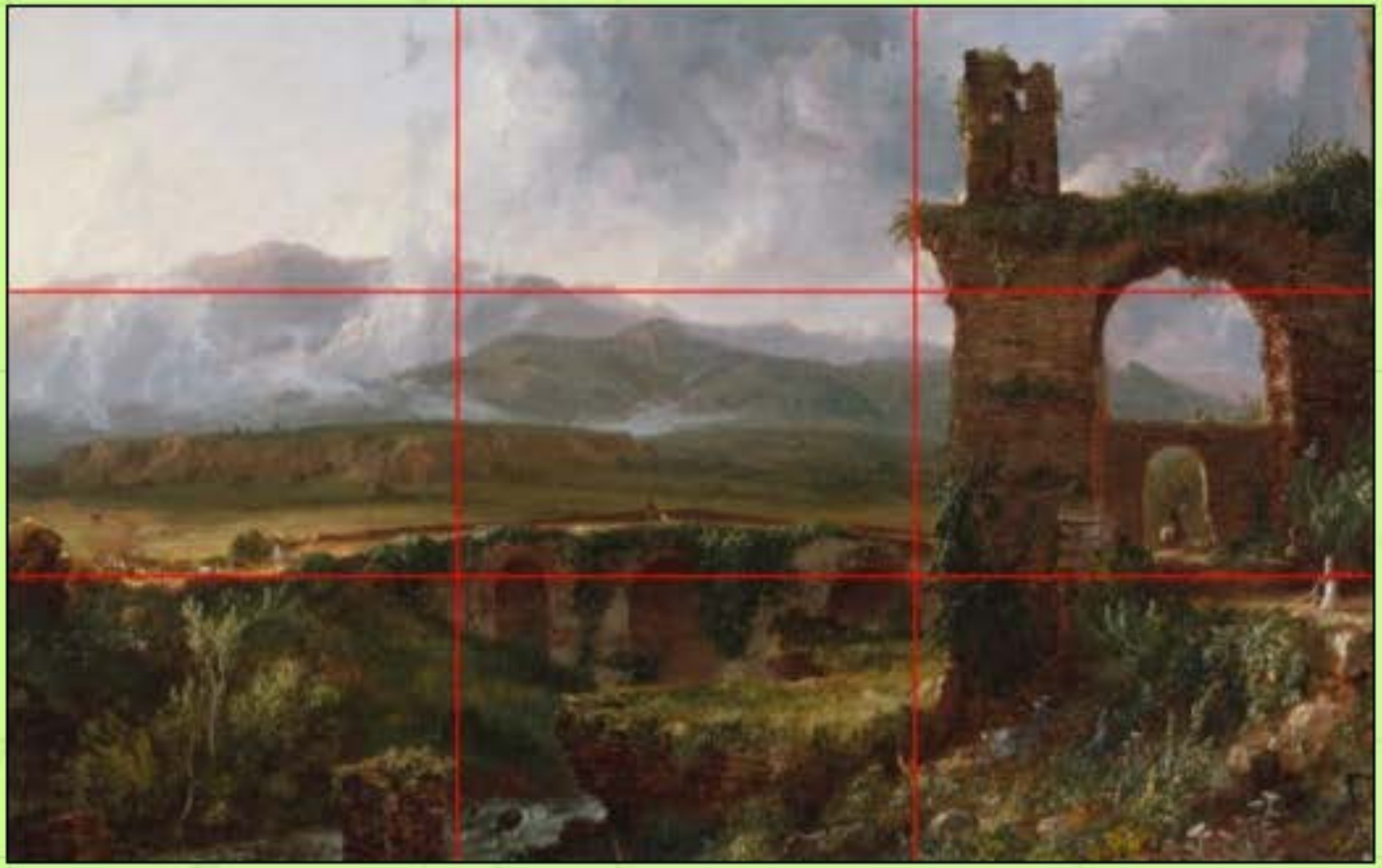




"when you are at waterside or in a field or in the meadows you can look through it as through a window; the vertical lines and the perpendiculars of the grid as well as the diagonals and where they intersect, as well as the divisions into sections, all give fundamental reference points. With their help you can make a solid drawing, from getting the indication of the main lines and proportions"

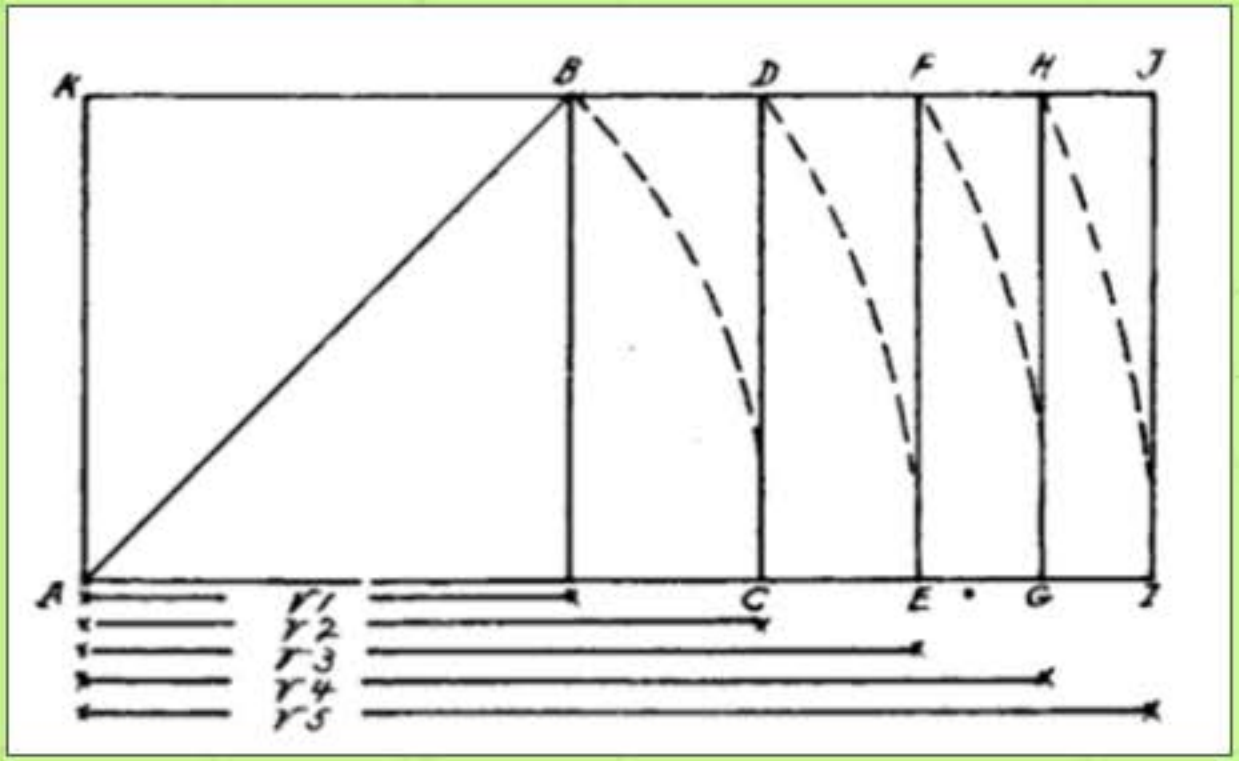
Vincent van Gogh

The Rule of Thirds



The rule of thirds proposes that an image should be divided into nine equal parts by two equally spaced horizontal lines and two equally spaced vertical lines, and that **important compositional elements should be placed along these lines or their intersections.**

Dynamic Symmetry

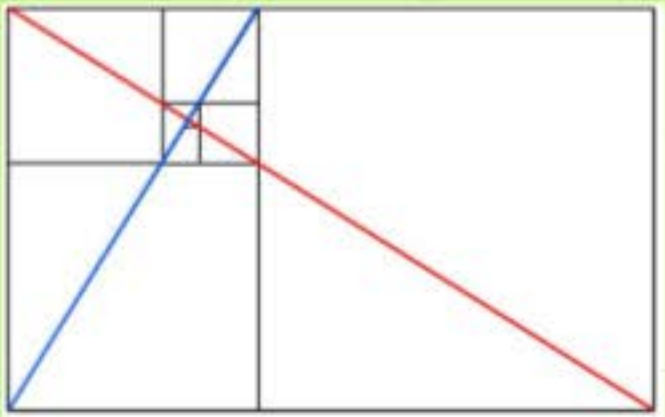


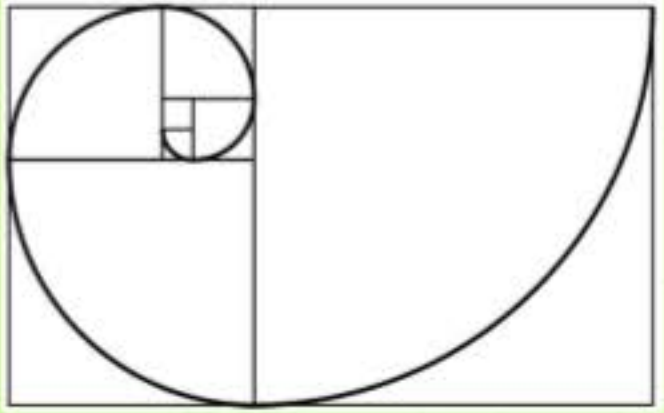
Dynamic Symmetry is a proportioning system used by some artists to divide root rectangles into image composition grids. When applied to root rectangles, dynamic symmetry yields grids with aesthetically pleasing ratios in their proportional relationships.

Hambidge's system relied on the use of root rectangles. However the diagonal rules can be used to create a grid system for any rectangle. This dynamic dynamic symmetry grid appears to have some very interesting mathematical properties.

https://colinfizgig.github.io/DynamicSymmetry/

The elements of the rectangle





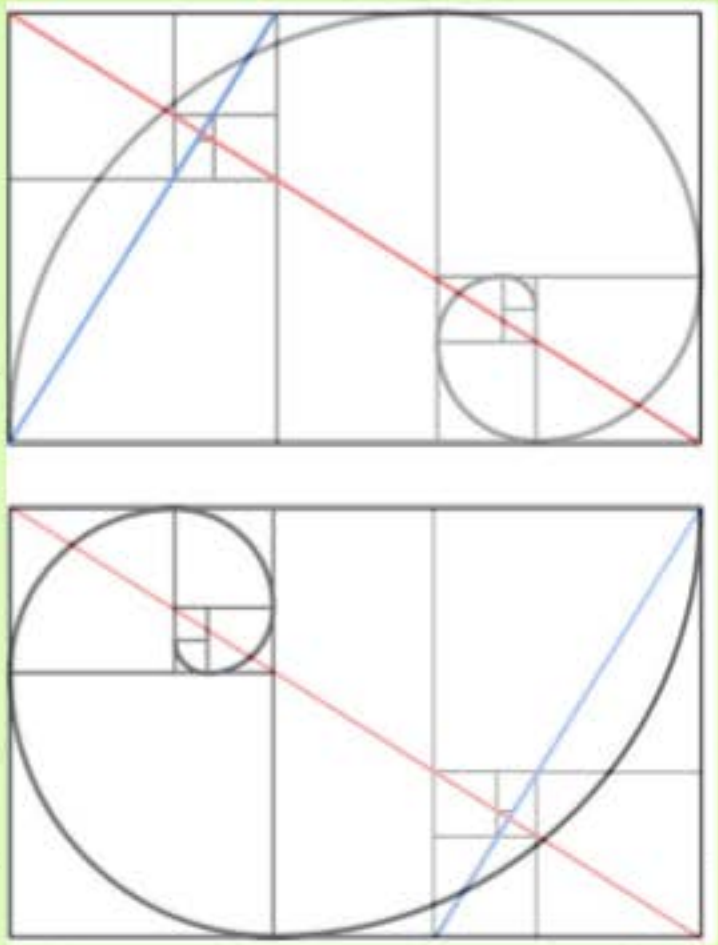
"For the purposes of design **the most important element of a rectangle is its diagonal**. "

"The element of a rectangle second in importance to the diagonal, is the diagonal of a reciprocal. The diagonal of the reciprocal of a rectangle cuts the diagonal of the whole at right angles."

Jay Hambridge

What this means is that that any rectangle can be divided into smaller versions of itself using diagonals and right angles. This division corresponds to the Fibonacci spiral on a 'golden rectangle'.

Framed Symmetries

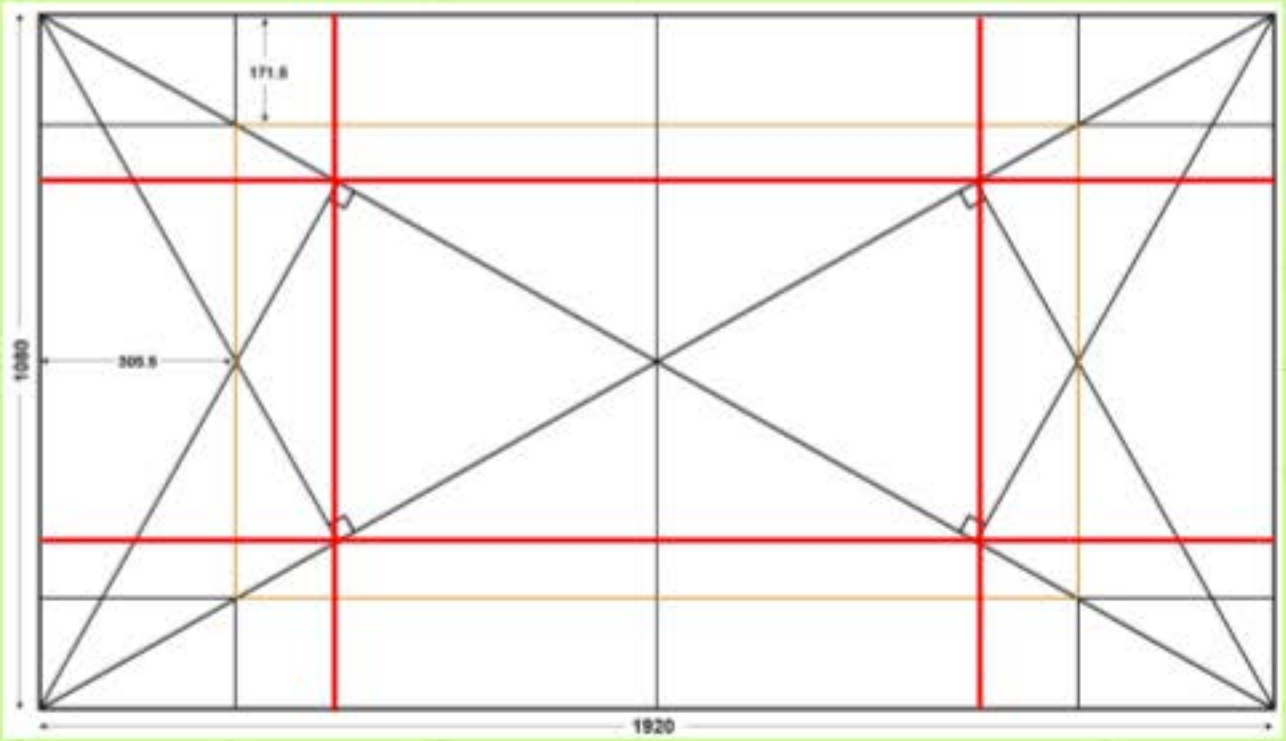


Flipping and mirroring these transforms creates diagonals whose intersections can be used to create a grid system similar to the rule of thirds.

This grid system has four nodes of interaction at the intersection of each diagonal. These nodes of interaction correspond to aesthetically pleasing proportions based on the golden proportion and asymmetrical relationships.

This balance between symmetry and asymmetry when applied to an image composition creates what is called dynamic symmetry.

Dynamic Symmetry nodes of interaction

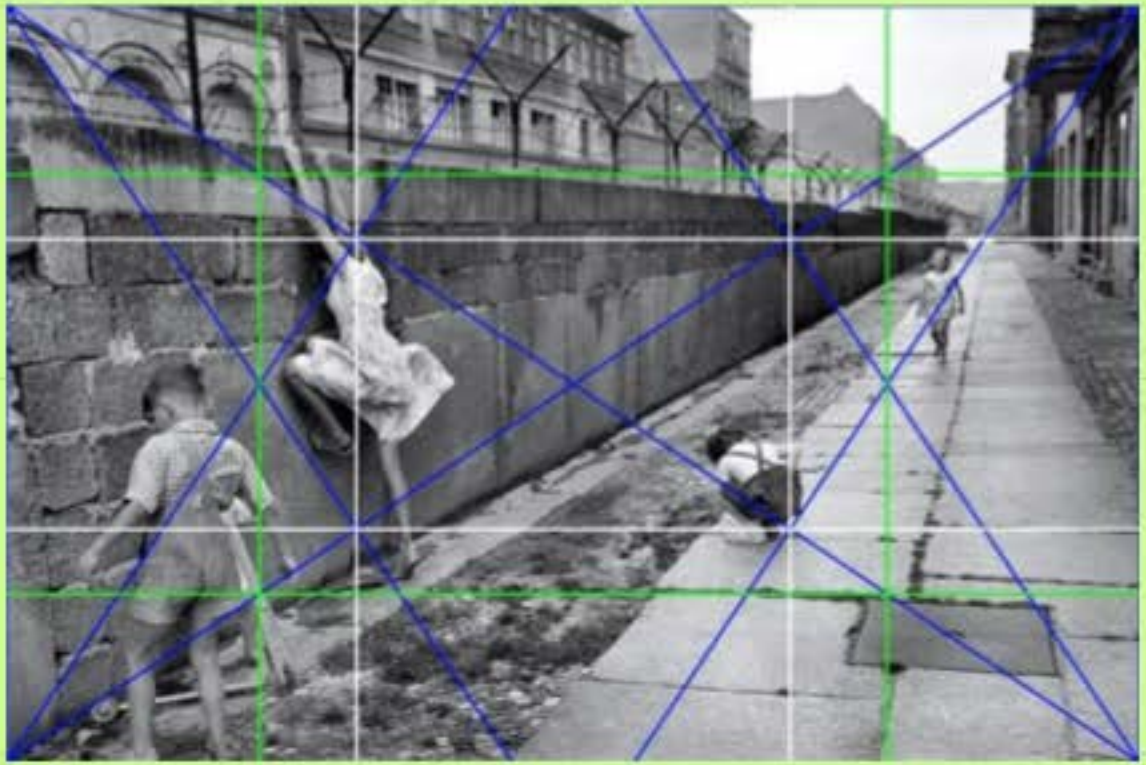


In addition the other intersections within the dynamic grid structure can be used to create additional lines for reinforcing the grid.

You may notice this most often at the intersections of the bisecting diagonal lines which will always intersect at the **geometric mean** of an arc from any side of the rectangle.

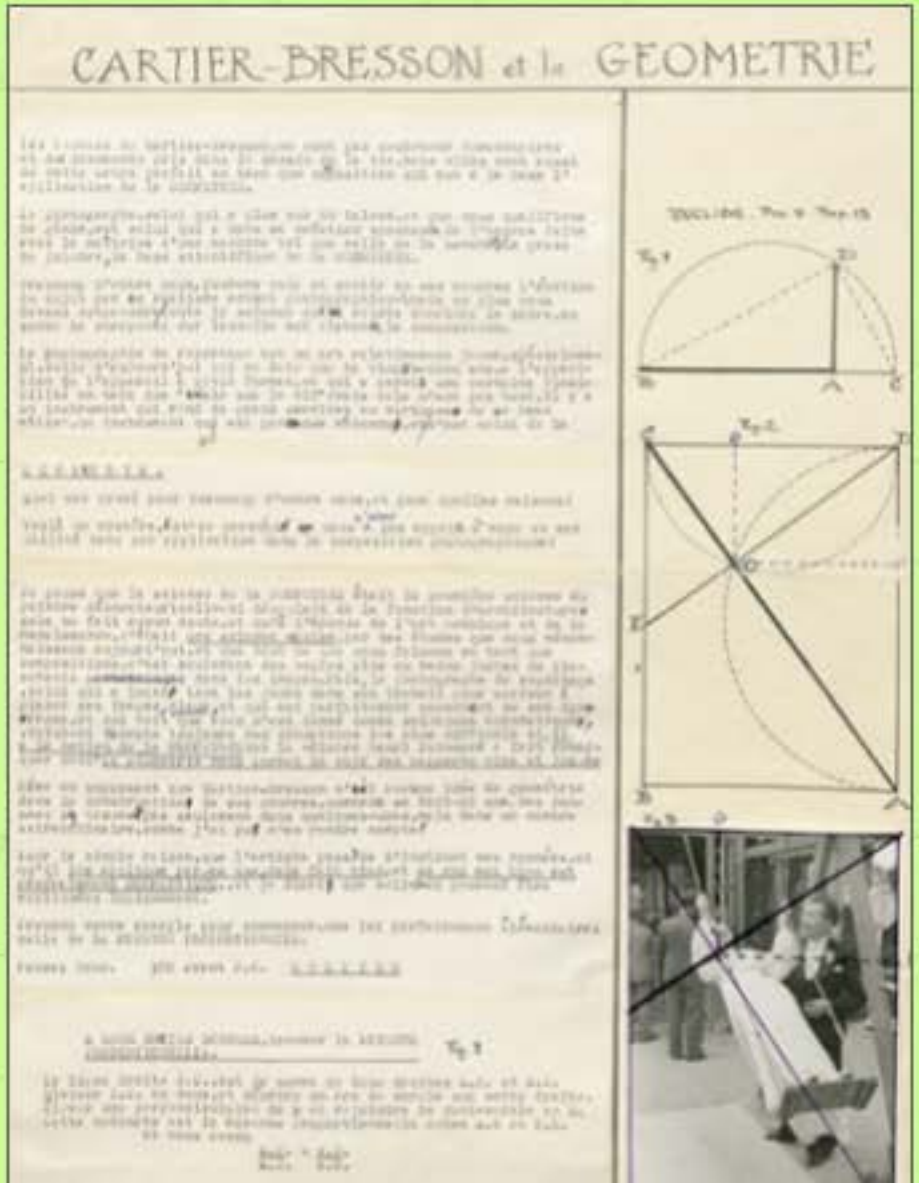
https://colinfizgig.github.io/DynamicSymmetry/

Dynamic Symmetry: Henri Cartier-Bresson



Henri Cartier-Bresson was a master of candid street photography. He believed you could develop your perception to see the best composition of a scene in an instant and most of his photography was shot with little or no setup. The nature of the photos would imply that Bresson was hardwired to see the composition in an instant, as he claimed, and based on his success the aesthetics of the images cannot be denied.

Dynamic Symmetry: Henri Cartier-Bresson



Maurice Tabard was a French Surrealist Photographer. The image to the right shows document Tabard put together for the Chicago exhibition in 1948. Tabard constructs and discusses a photograph by Cartier-Bresson ("Mariage à Joinville-le-Pont, France", 1938) showing the geometric structure of his photographs. Tabard argues that they are not only humanitarian documents but also geometric constructions. The top diagram shows Euclid's proof for the geometric mean. The center image illustrates the same principle using Hambidge's two most important elements of a rectangle construction aka. Dynamic Symmetry.

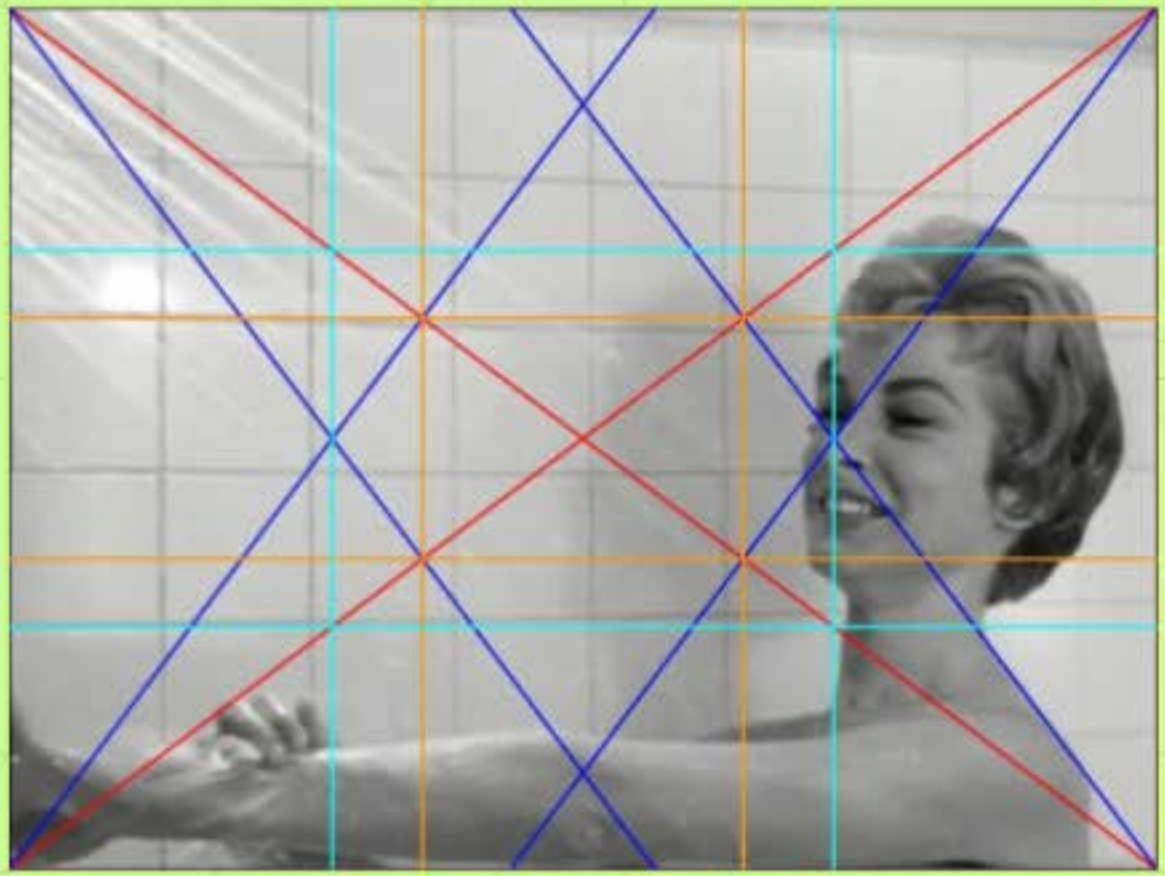
Dynamic Symmetry: Andre Lhote

The reintegration of painting i
with the aid of mathematical rath
public manifestation of which took
pushed the study of traditional p
elements of a picture a very lon
various painters before them, an
the length of the shorter side on
the frame. Repeating the operati
which overlap. If you draw the d
of the rectangle, you get a play
network in which the natural fo
to wed those thus defined, weav
feel that the different parts subject
very format of the canvas are bou
spoken of as rhythm.

But there is a method of dividi
ting on profound laws governing
is what Leonardo da Vinci call
Luca Pacioli undertook in the 16

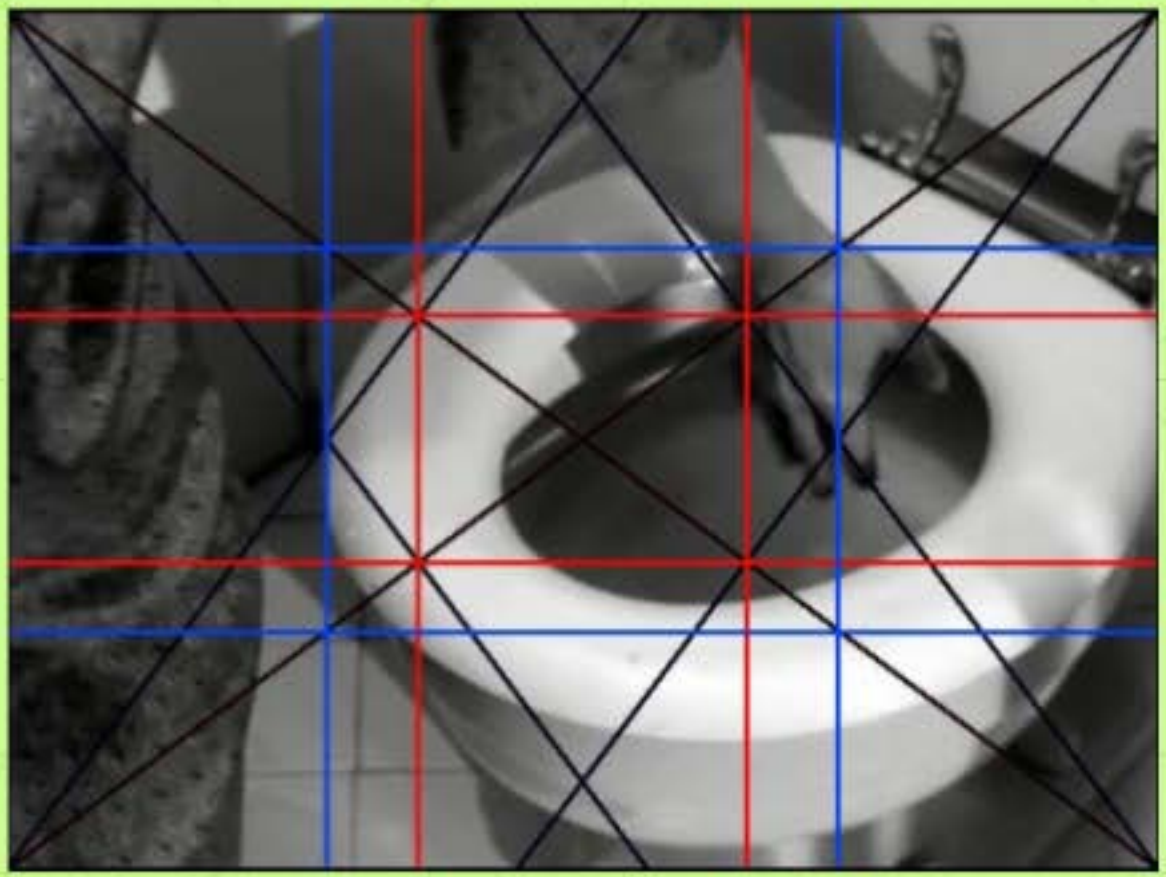
Bresson studied painting under the French cubist painter Andre Lhote. Lhote was a member of Section d'Or. Lhote himself was an ardent student of geometry. Lhote was exploring geometric composition well before Hambidge published his book. The image to the left shows an excerpt from Lhote's book on landscape painting in which he describes his process for constructing composition based on the Golden Section and other elements of geometry.

Dynamic Symmetry: Alfred Hitchcock



Alfred Hitchcock is one of the most widely respected film directors of the twentieth century. Generally, it is believed his films follow the rule of thirds composition, but like Henri Cartier-Bresson, Hitchcock's compositions overlap extensively with a dynamic symmetry grid system. It should be noted that parts of the rule of thirds grid will fall within the grids created by dynamic symmetry when applied to the 1.33:1 aspect ratio that Hitchcock shot for most of his career.

Dynamic Symmetry: Alfred Hitchcock

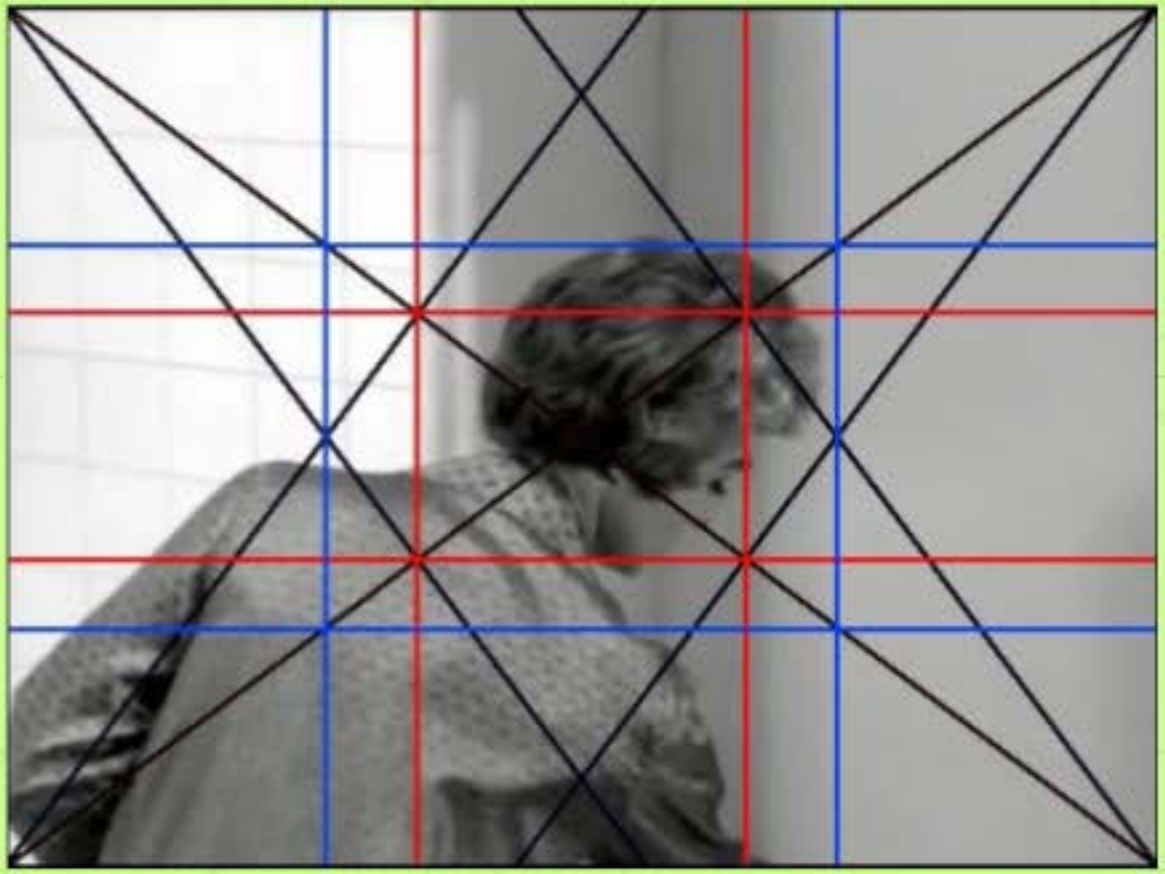


This famous scene from the movie Psycho was shot based on storyboards provided by Saul Bass. The rule of thirds would fall somewhere between the red and blue grid lines. This scene is extremely complex with over 78 setups and 52 cuts. I've taken the first frame of each cut and overlaid the dynamic symmetry grid.

In this shot the hand aligns with the eye points as well as some edge and directional alignment with the walls, cloth and hand.

(1,0,0)

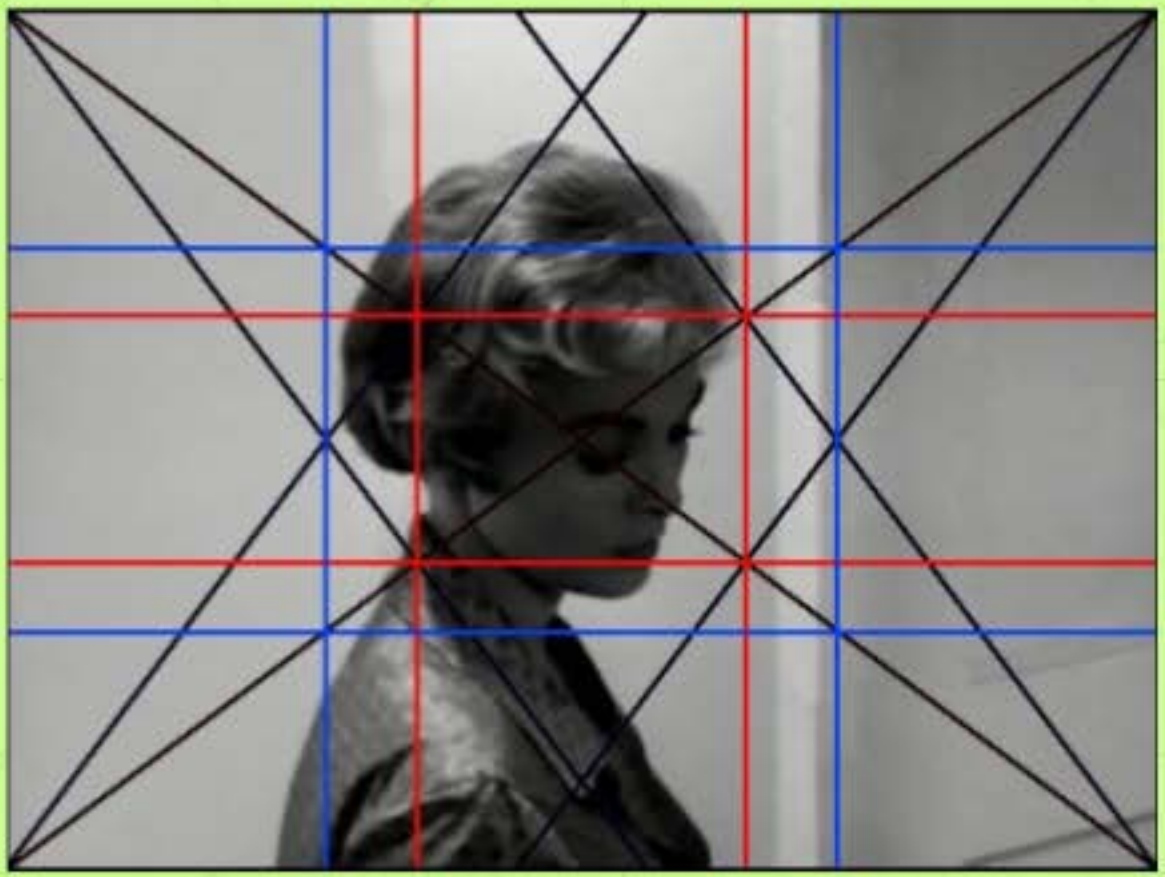
Dynamic Symmetry: Alfred Hitchcock



The edges and shadows of the walls align as well as her body tilt and the direction of her gaze.

(2,0,0)

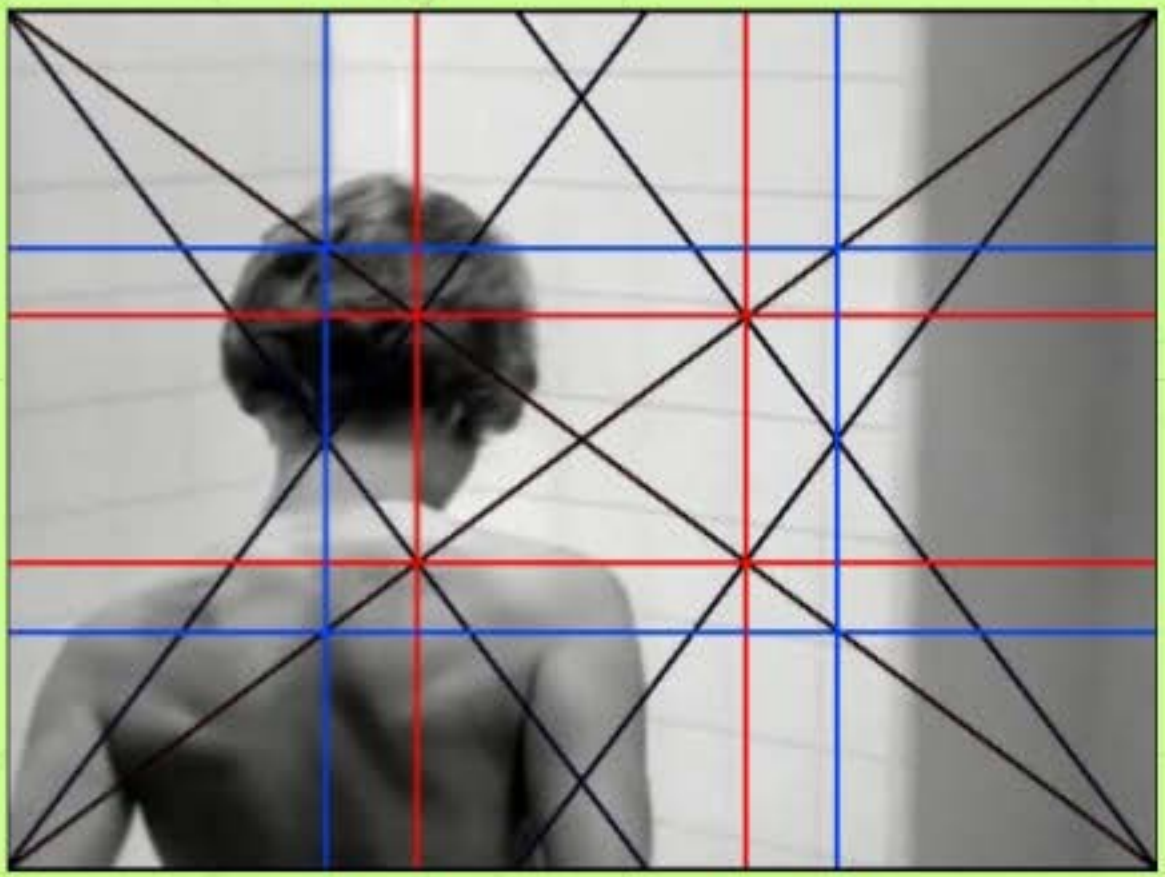
Dynamic Symmetry: Alfred Hitchcock



Her gaze and the edge of the door align. I call this one loosely aligned.

(2,1,0)

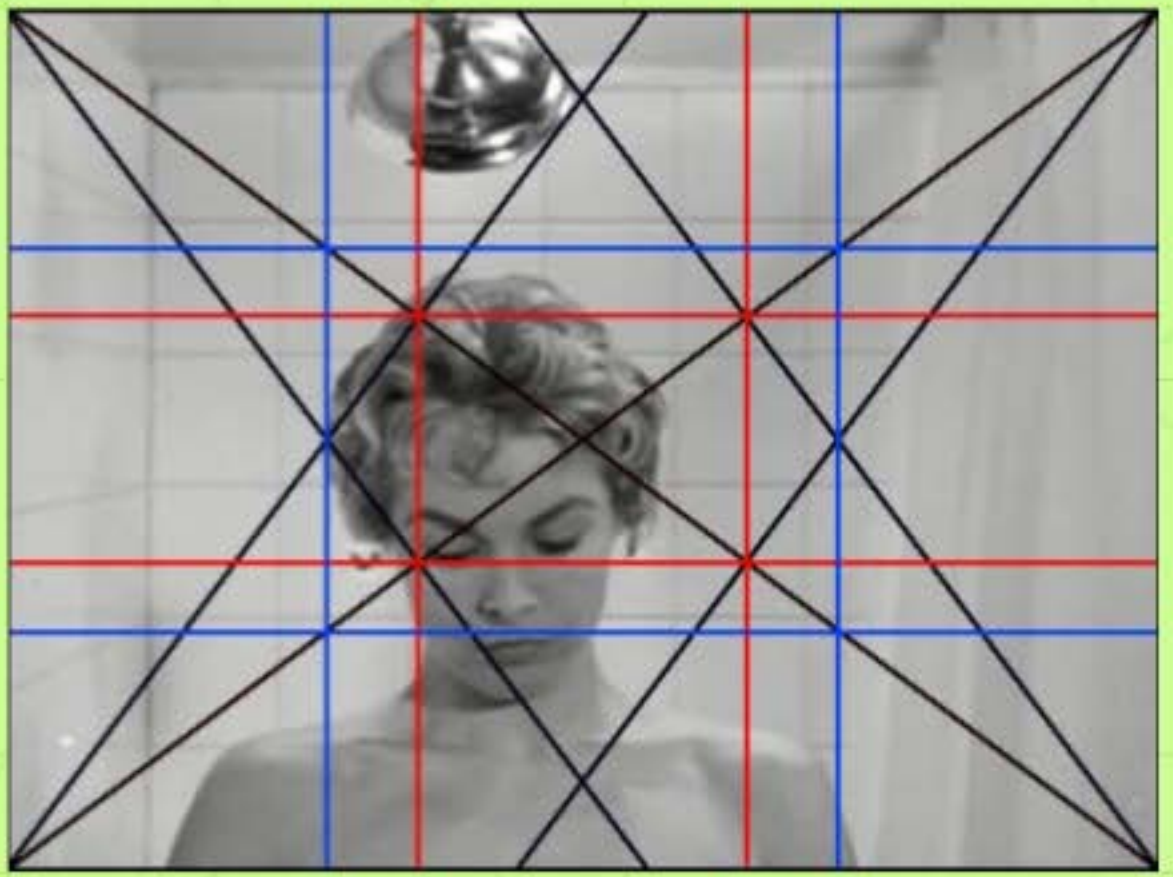
Dynamic Symmetry: Alfred Hitchcock



Her body, the shower corner and the center of her shoulders align farely well.

(3,1,0)

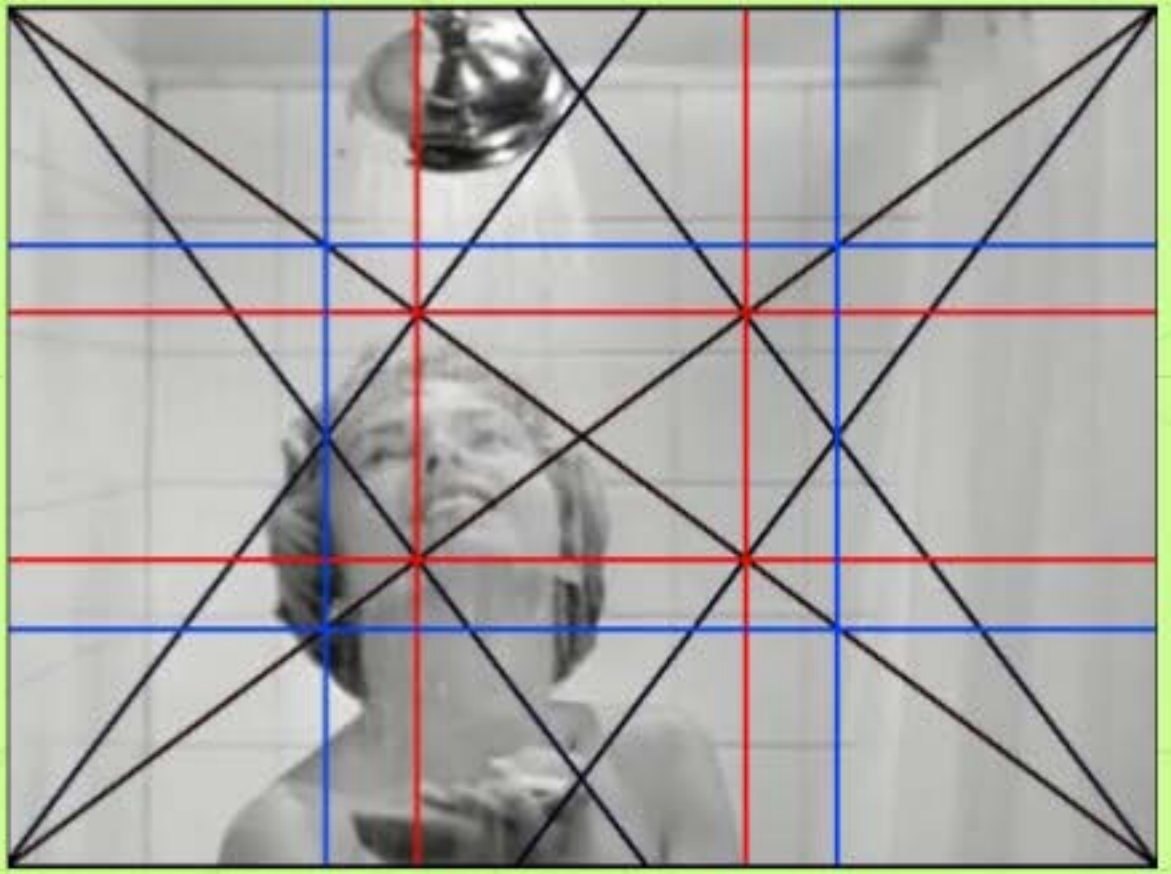
Dynamic Symmetry: Alfred Hitchcock



Other than her eye and perhaps the shower head not much else aligns here.

(3,2,0)

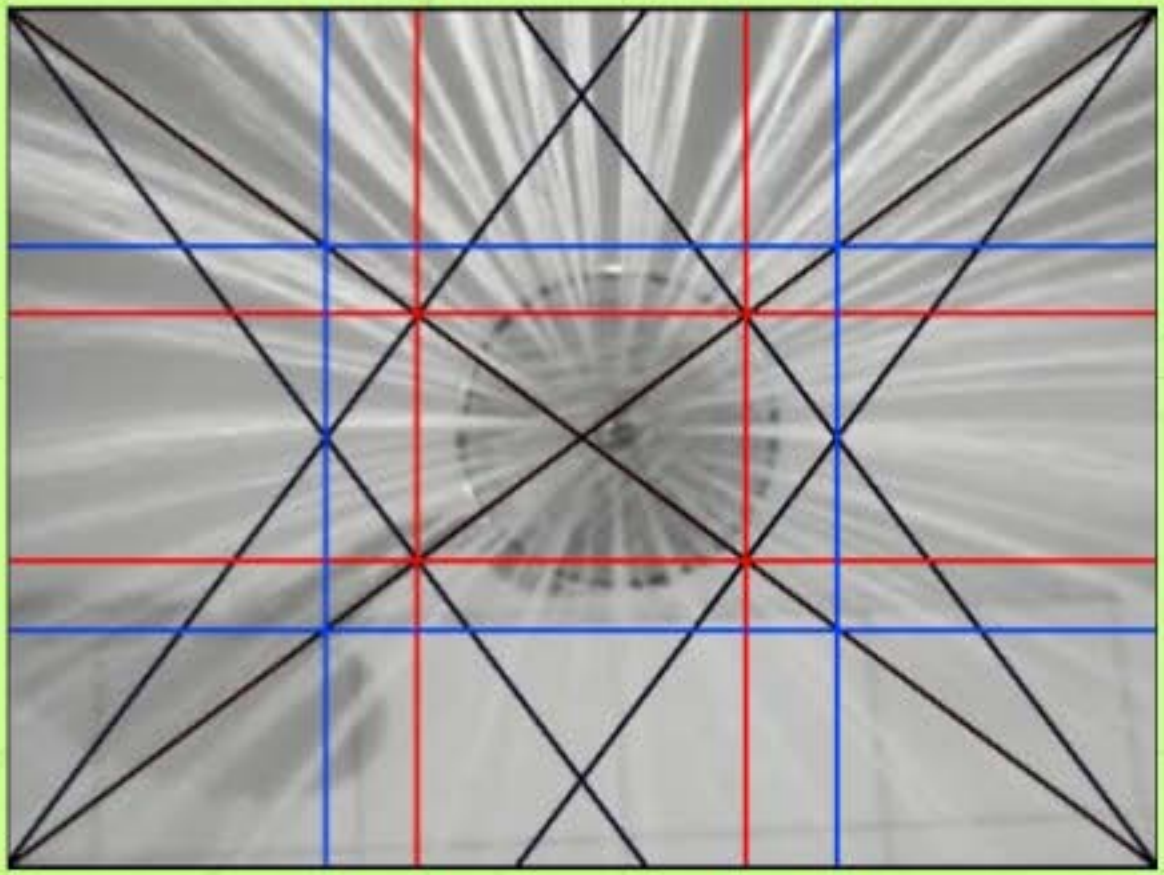
Dynamic Symmetry: Alfred Hitchcock



Other than her eye and perhaps the shower head not much else aligns here.

(3,2,0)

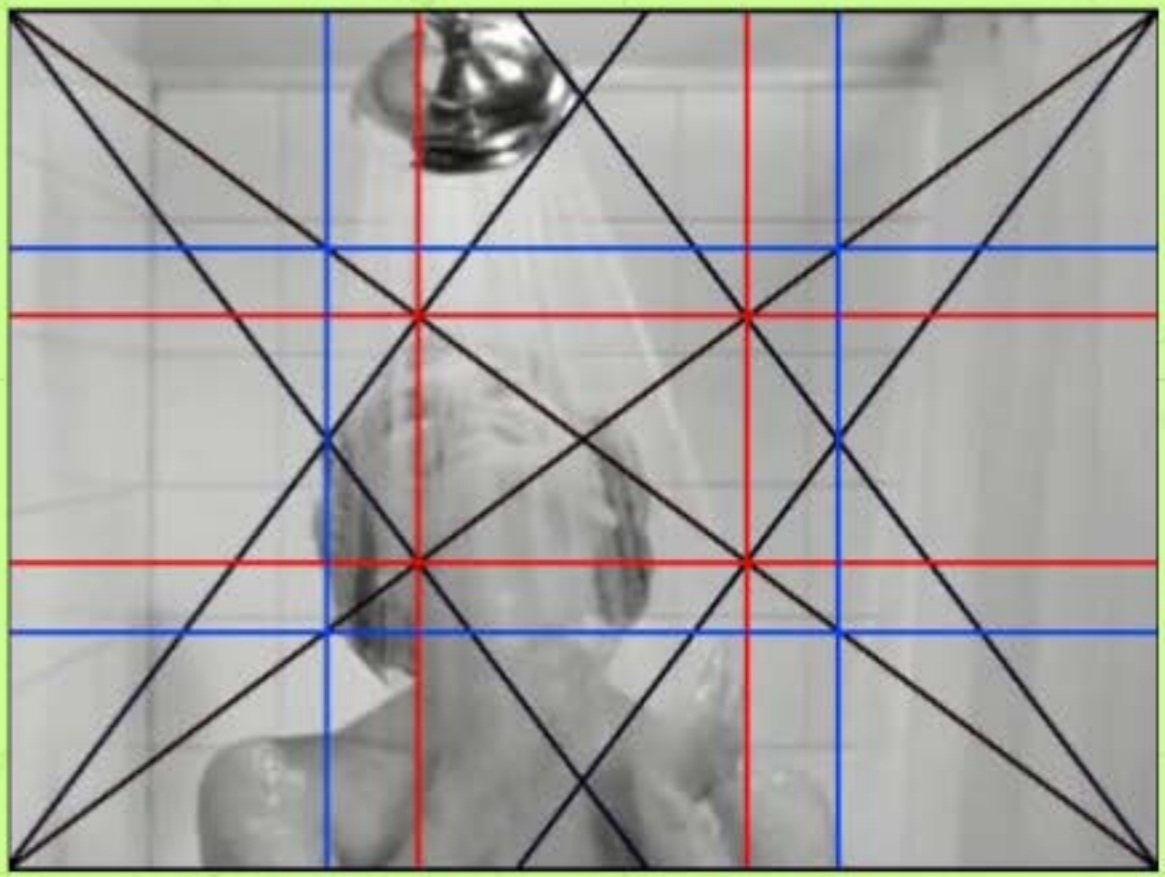
Dynamic Symmetry: Alfred Hitchcock



This seems pretty centered so I'll consider it not aligned with the grid.

(3,2,1)

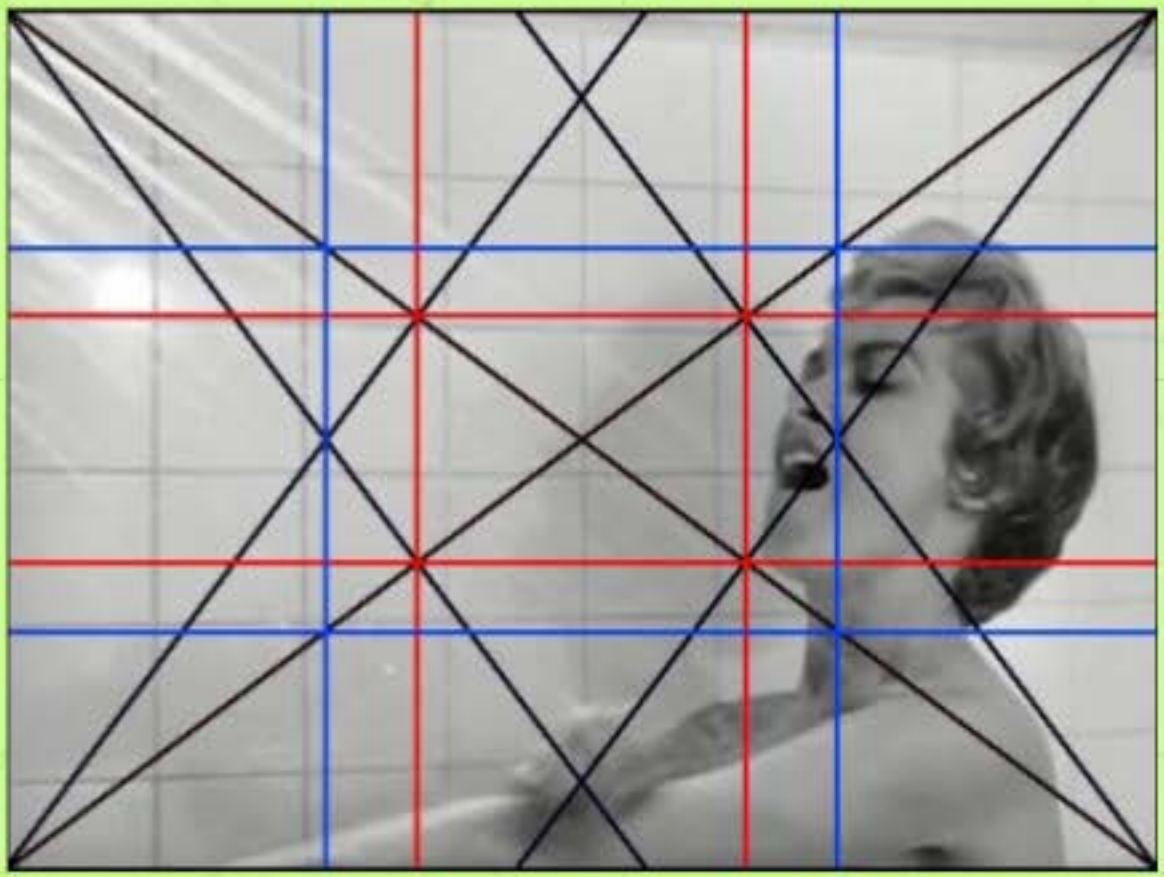
Dynamic Symmetry: Alfred Hitchcock



Another cut to the same shot as before.

(3,3,1)

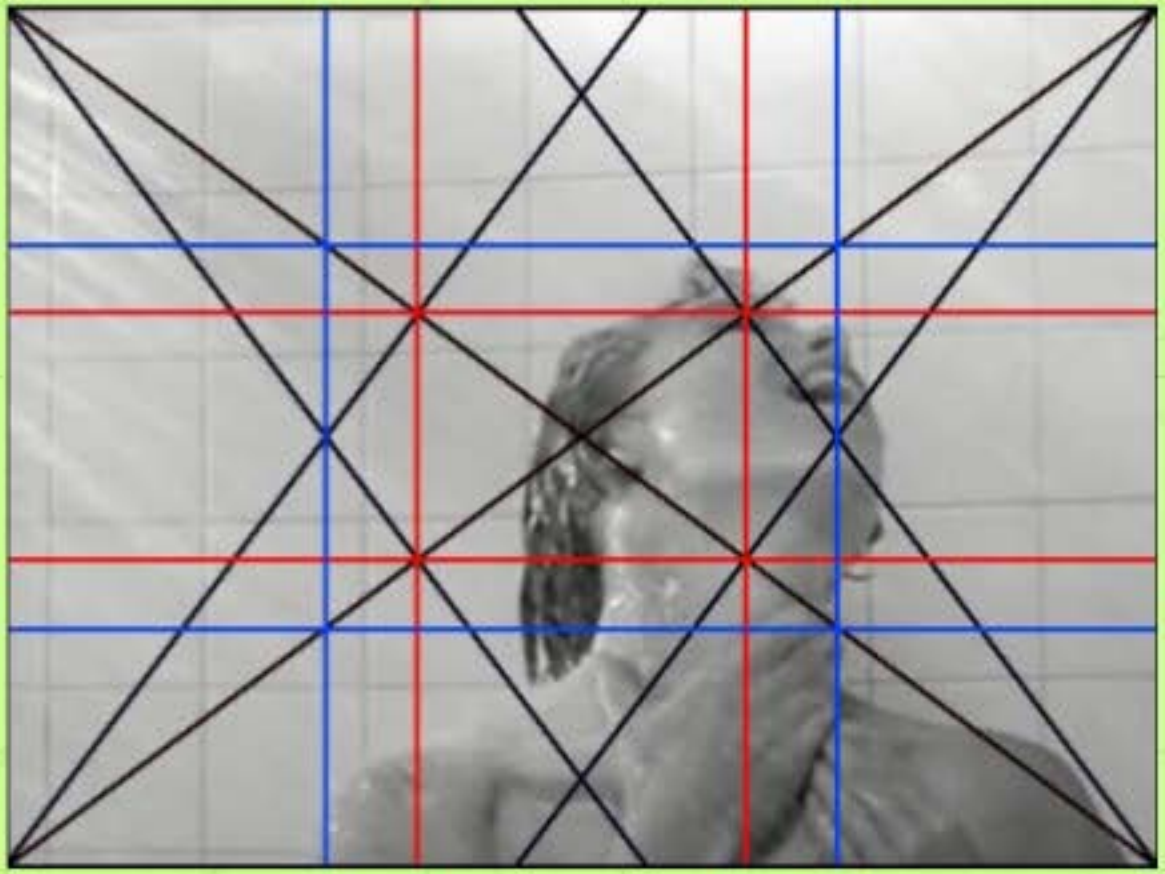
Dynamic Symmetry: Alfred Hitchcock



A nice cut to some pretty strong alignment with the sides and diagonals in the direction of the shower spray

(4,3,1)

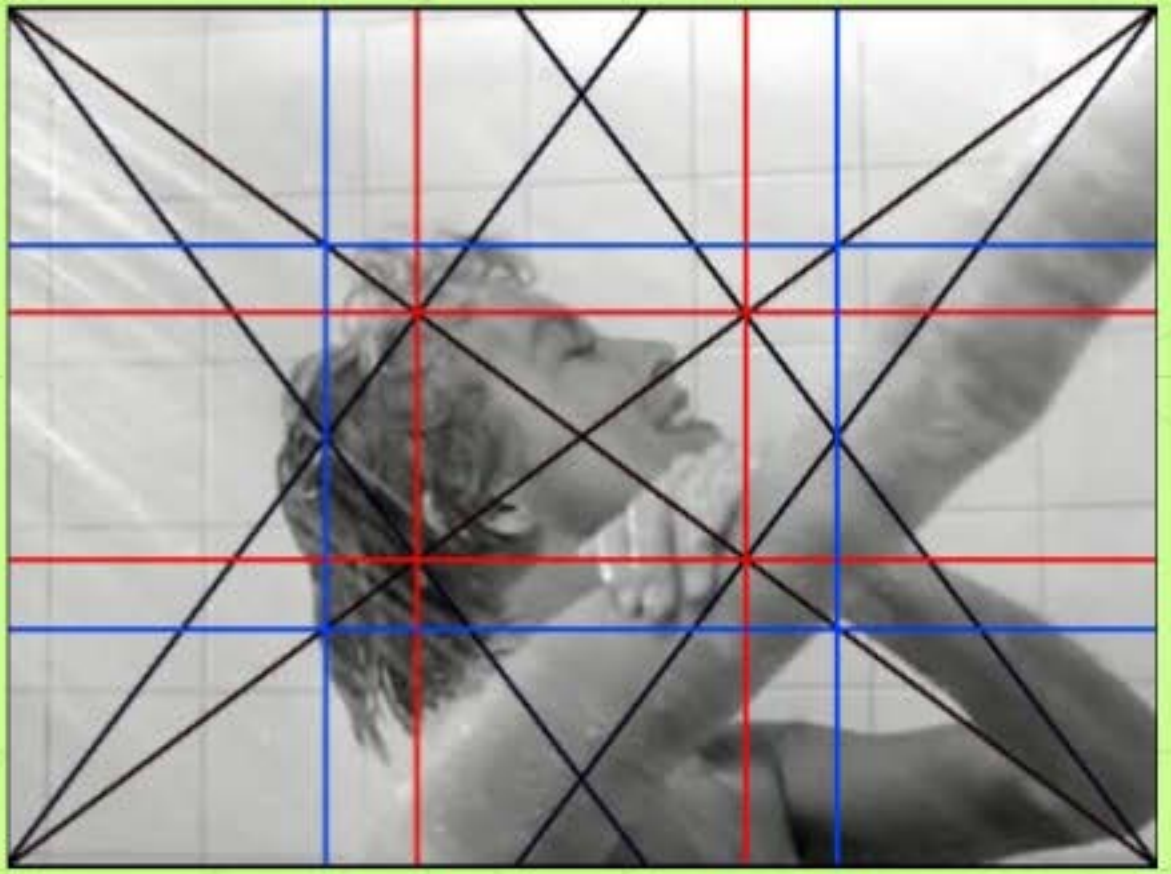
Dynamic Symmetry: Alfred Hitchcock



Her eye is directly on the eye point and the gaze is toward the diagonal. In addition her hand show up near the lower eye point next to her throat.

(5,3,1)

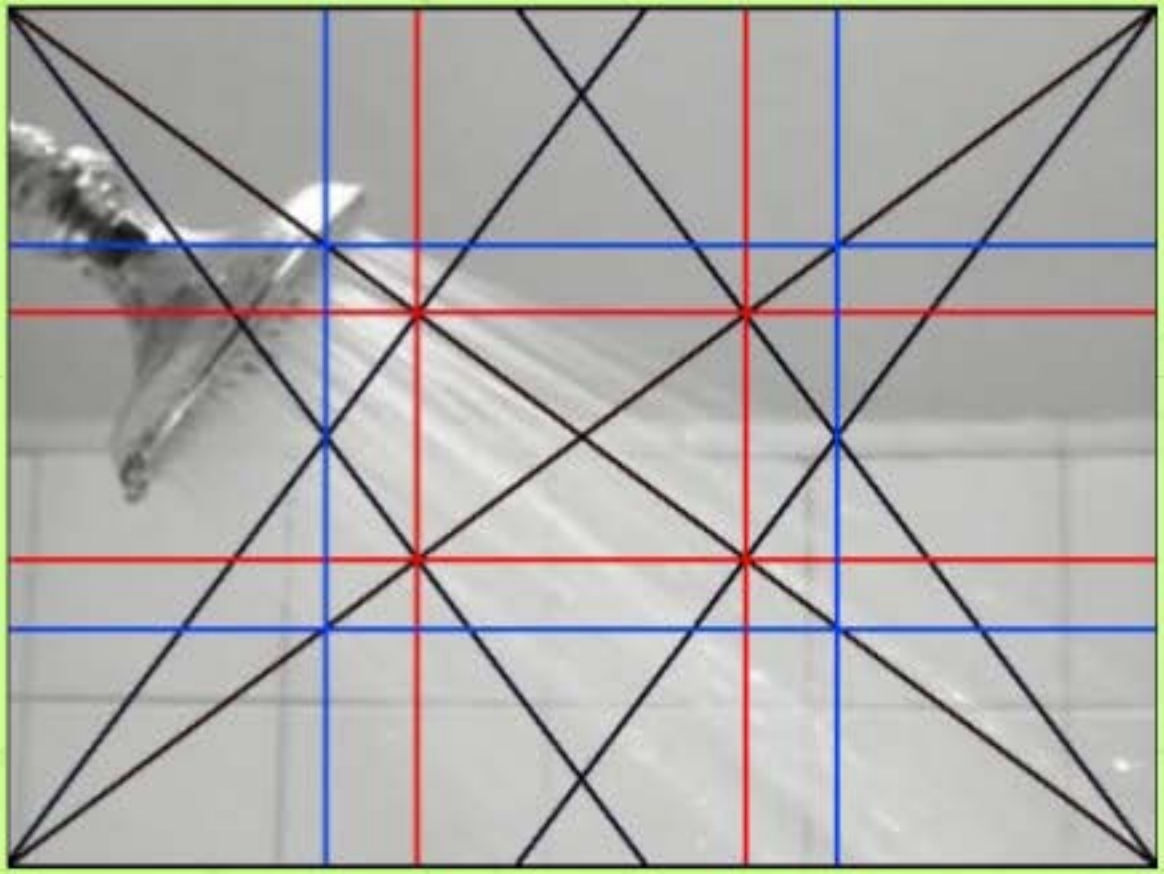
Dynamic Symmetry: Alfred Hitchcock



Even though she seems pretty centered in the shot there's so much diagonal alignment in this shot I consider it pretty heavily aligned to the grid.

(6,3,1)

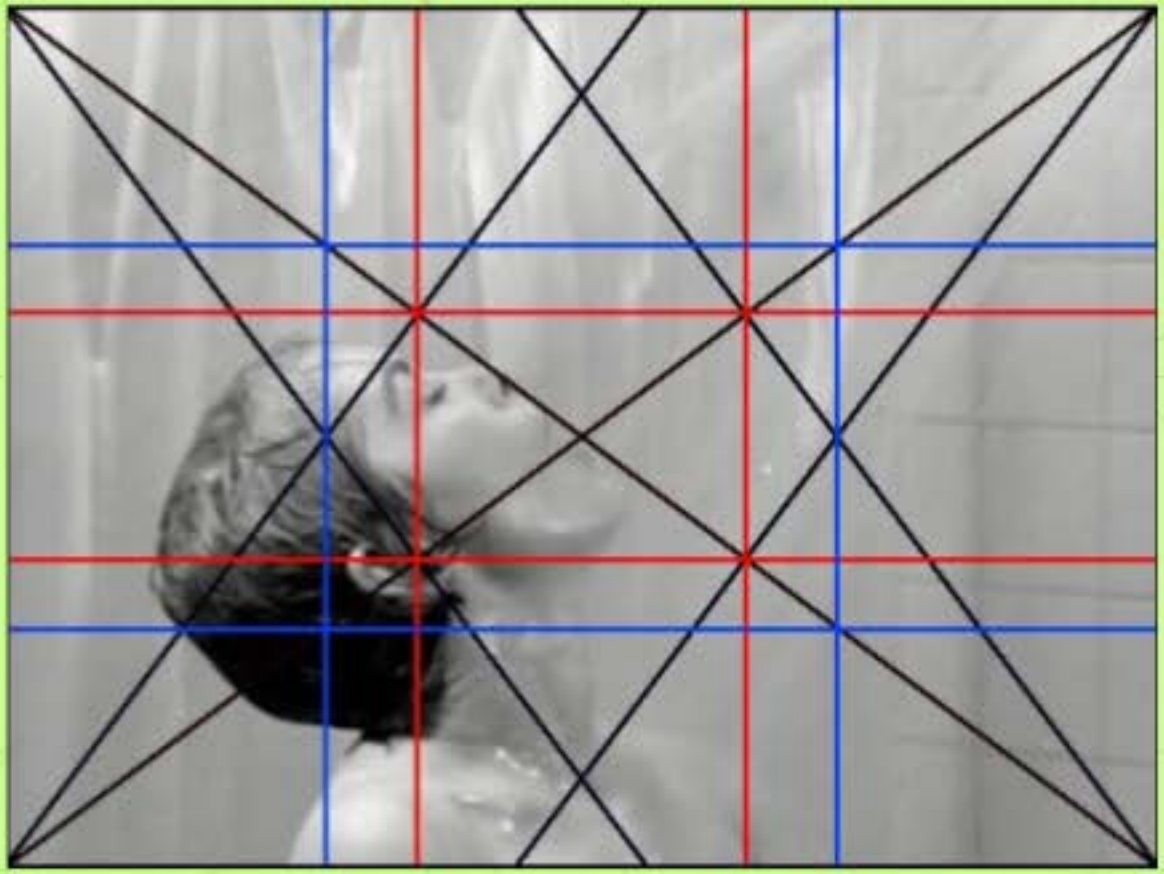
Dynamic Symmetry: Alfred Hitchcock



Positioned at the corner and aligned with the center horizontal. The grout lines don't align completely so I'd call it loosely aligned.

(6,4,1)

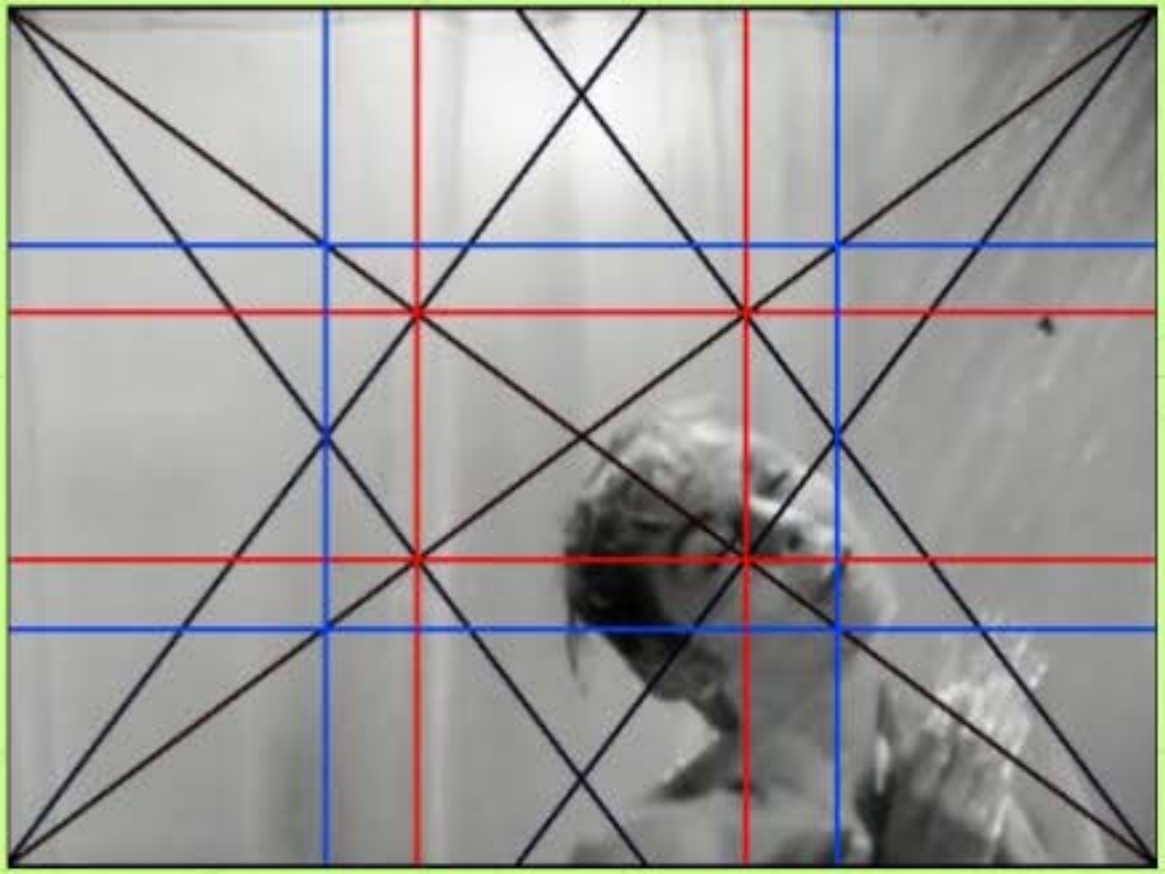
Dynamic Symmetry: Alfred Hitchcock



Pretty obviously aligned with the bottom eye point as well as the gaze.

(7,4,1)

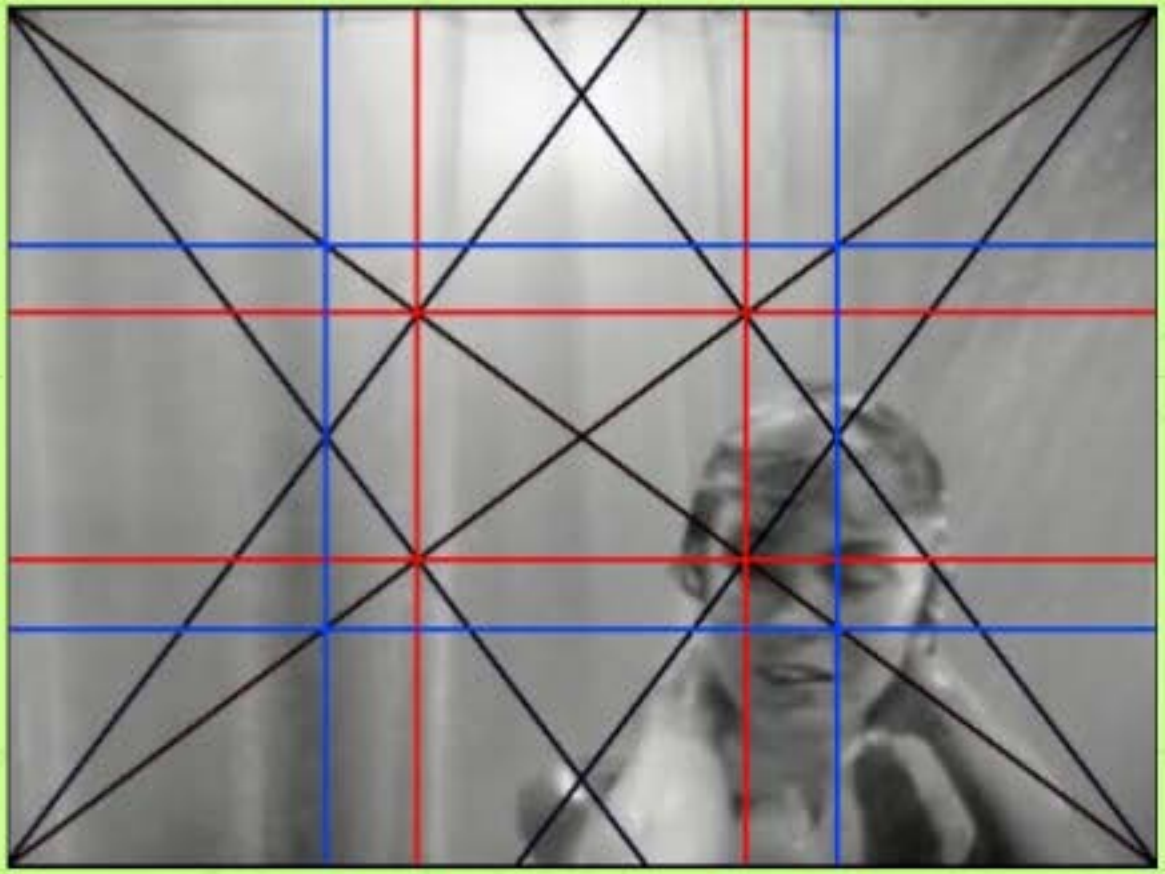
Dynamic Symmetry: Alfred Hitchcock



Enter Norman. The door cracks on the red vertical eye line and her head tilts with the bottom bisect. In addition you see her eye on the eyepoint.

(8,4,1)

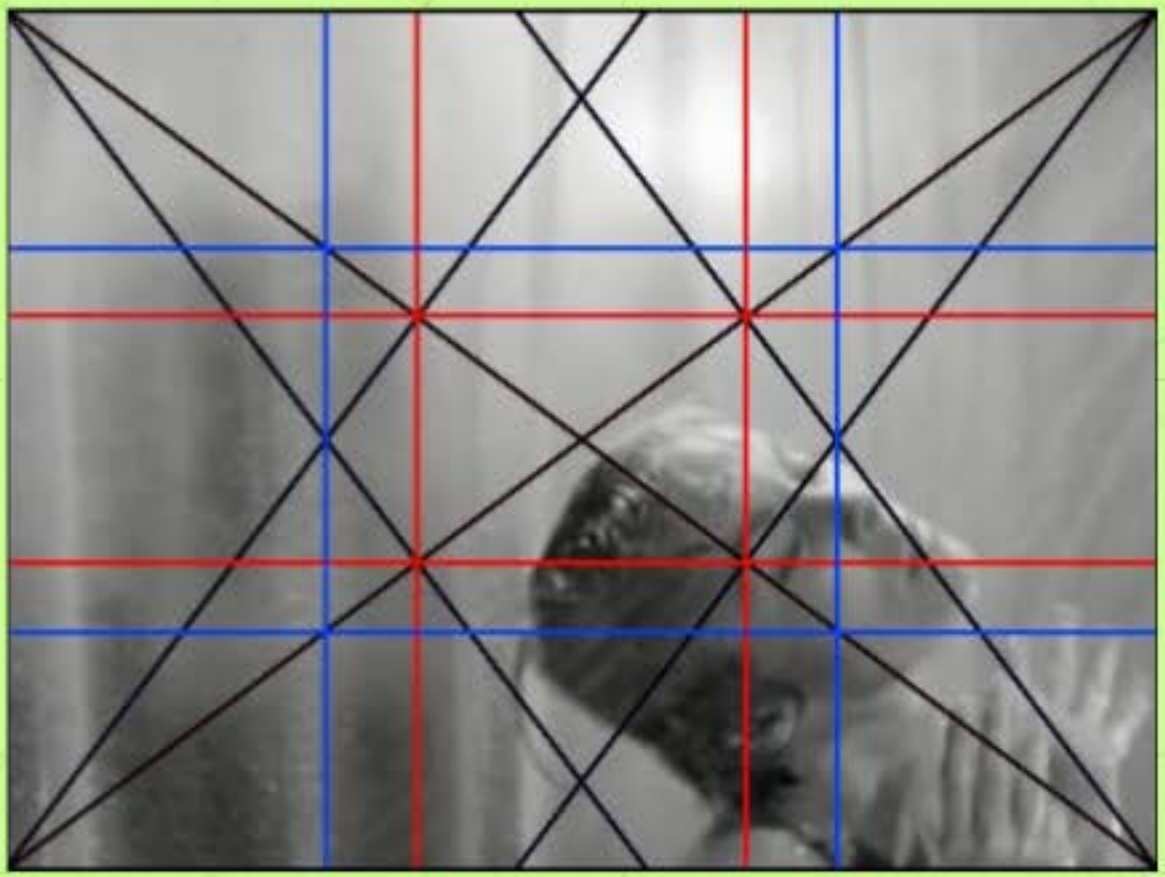
Dynamic Symmetry: Alfred Hitchcock



Norman's shadow shows up in the door at the outer line and her eye stays aligned on the lower right eyepoint. In addition her forearms and head make a nice reinforcing triangle to fit the right side bottom bisects.

(9,4,1)

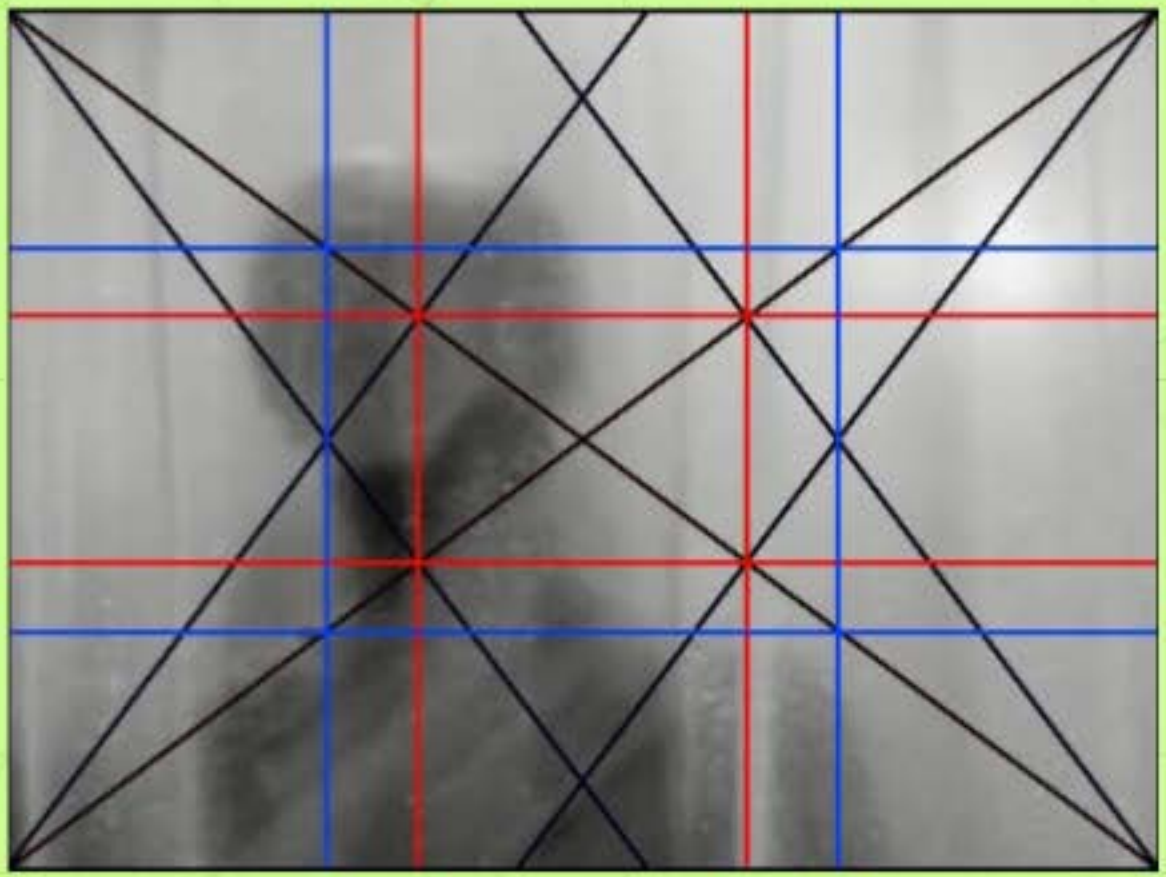
Dynamic Symmetry: Alfred Hitchcock



More of the same. The angle of the shower head is perfect as a gaze direction tool for this shot.

(10,4,1)

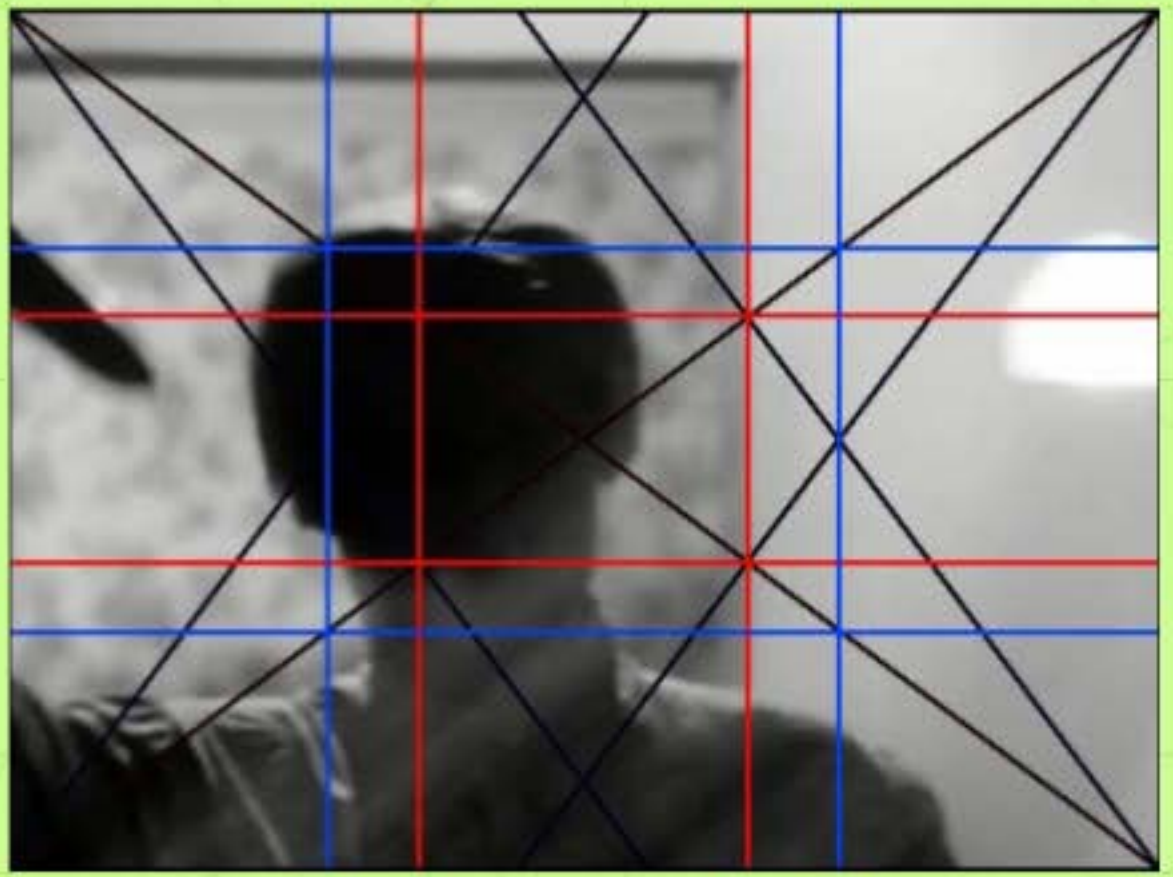
Dynamic Symmetry: Alfred Hitchcock



Norman on the vertical eye line and his eye height is at the horizontal eye line.

(11,4,1)

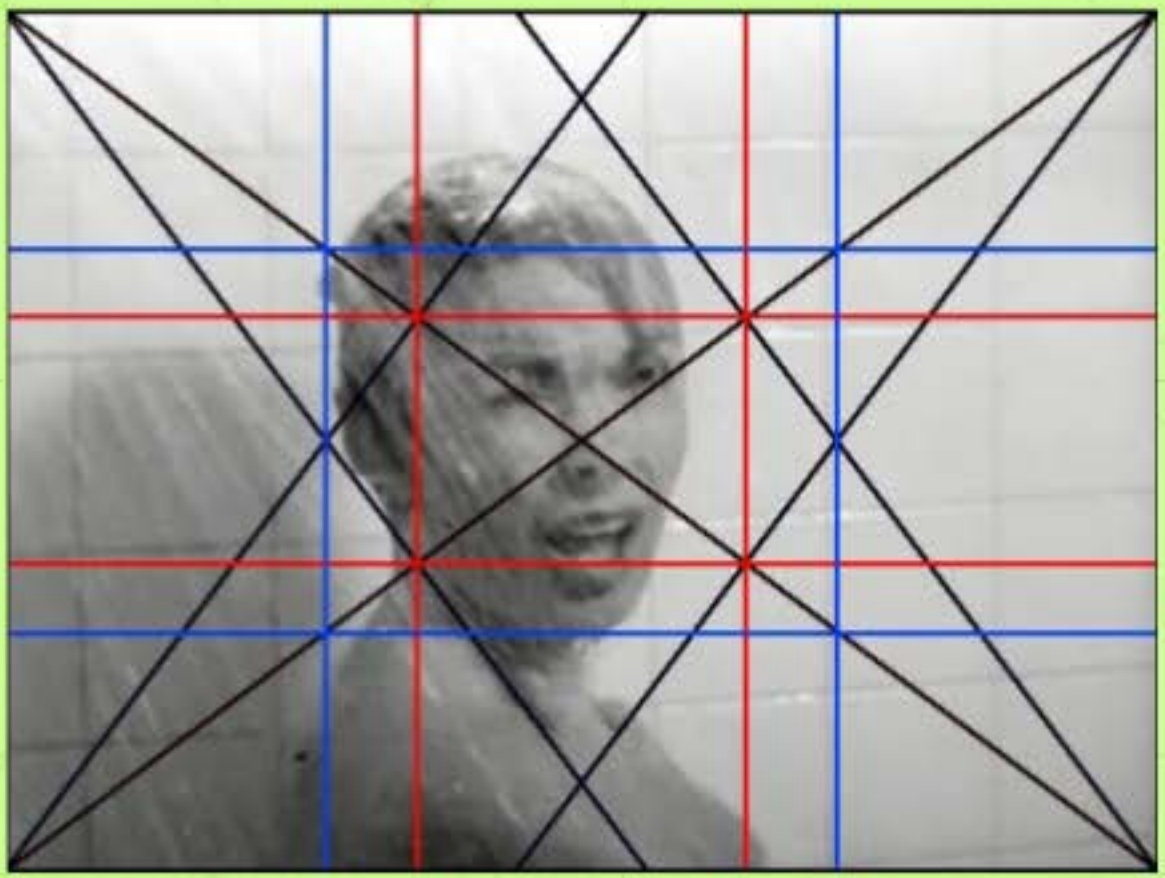
Dynamic Symmetry: Alfred Hitchcock



The door, the knife, the dagger angle, the backlight.

(12,4,1)

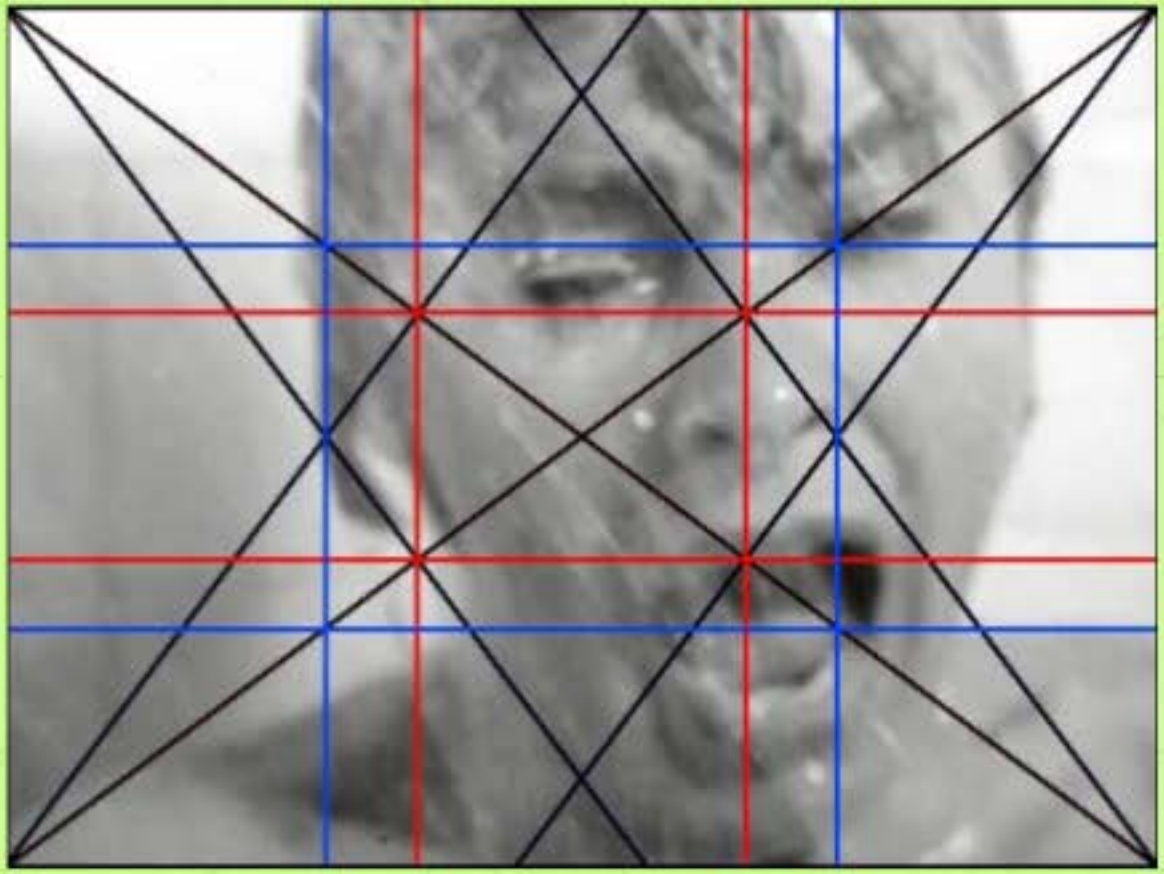
Dynamic Symmetry: Alfred Hitchcock



Even though I could argue there's some interesting interplay between her head shoulder and eye positions, I'll call this one barely aligned to keep it honest.

(12,4,2)

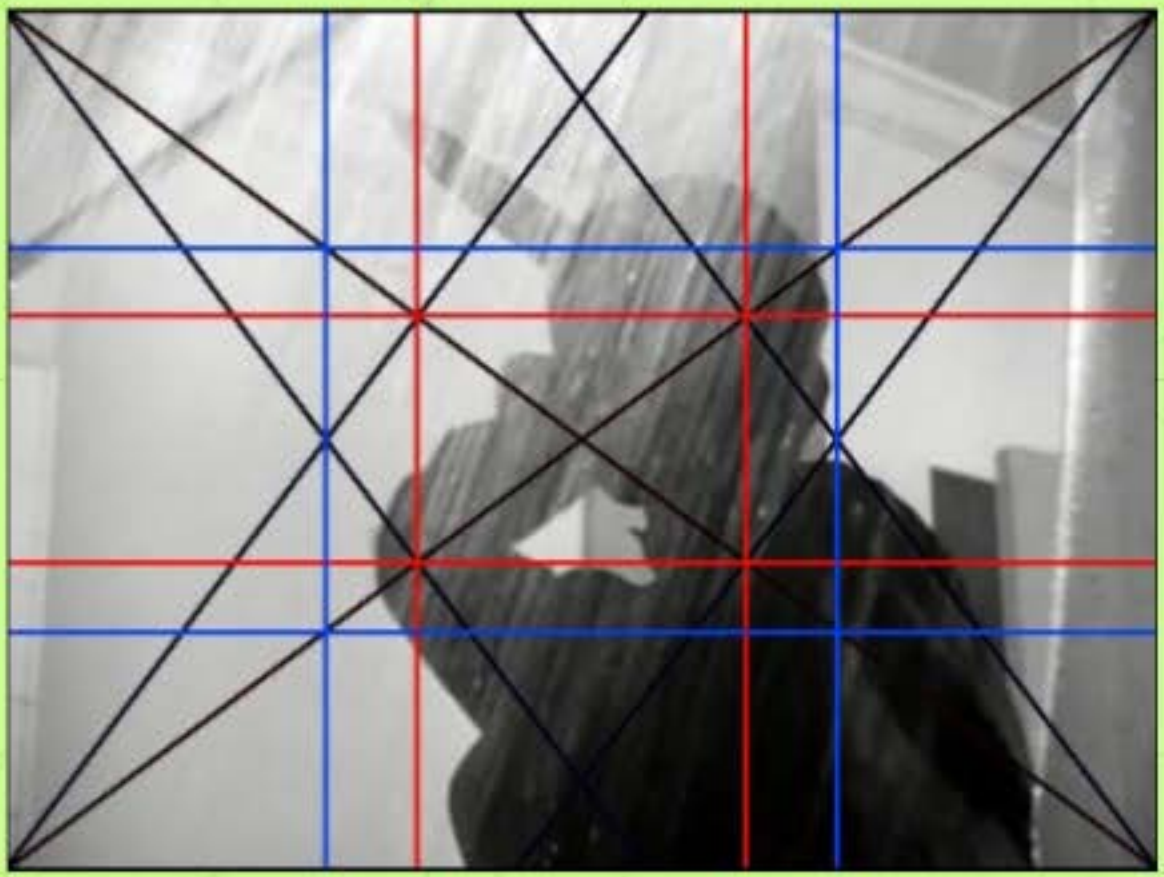
Dynamic Symmetry: Alfred Hitchcock



The mouth, the eyes, the side of the head.
I'll still call it loosely aligned.

(12,5,2)

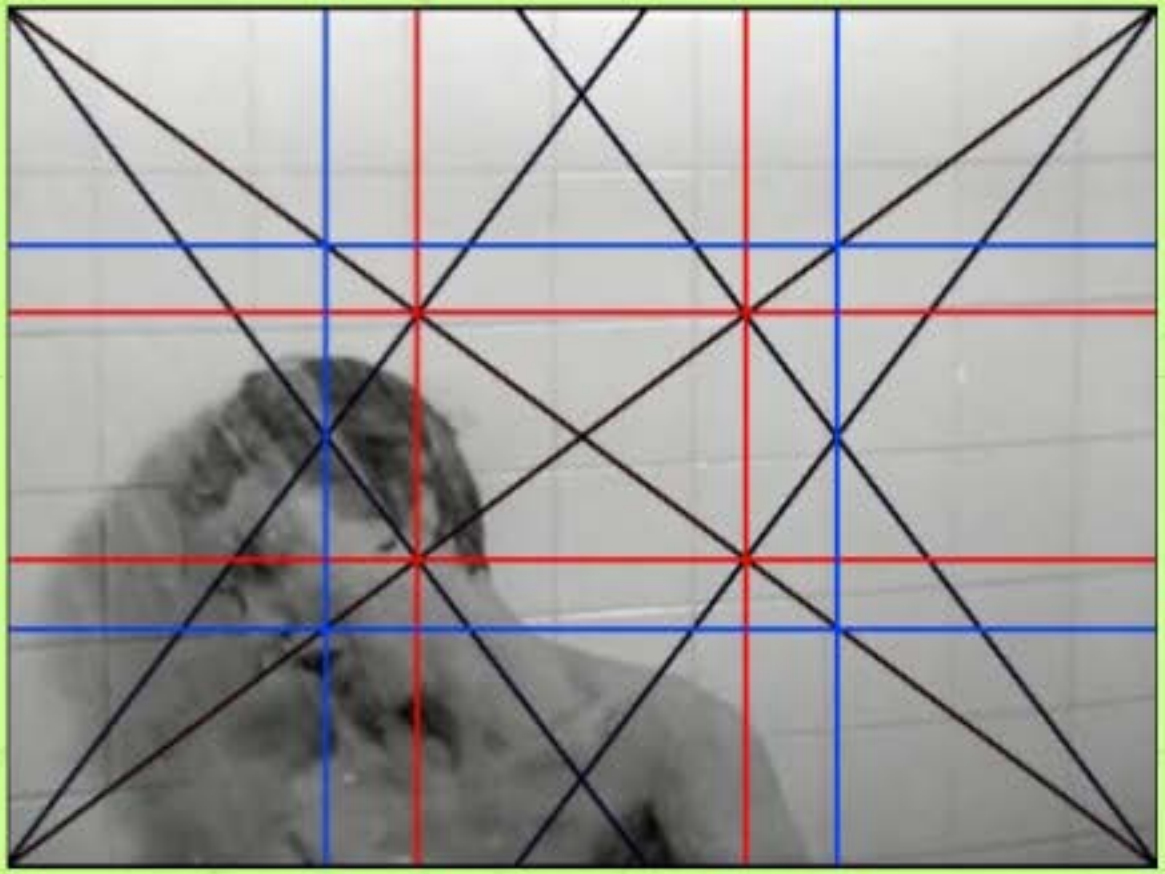
Dynamic Symmetry: Alfred Hitchcock



The position and angles align pretty strongly with the grid.

(13,5,2)

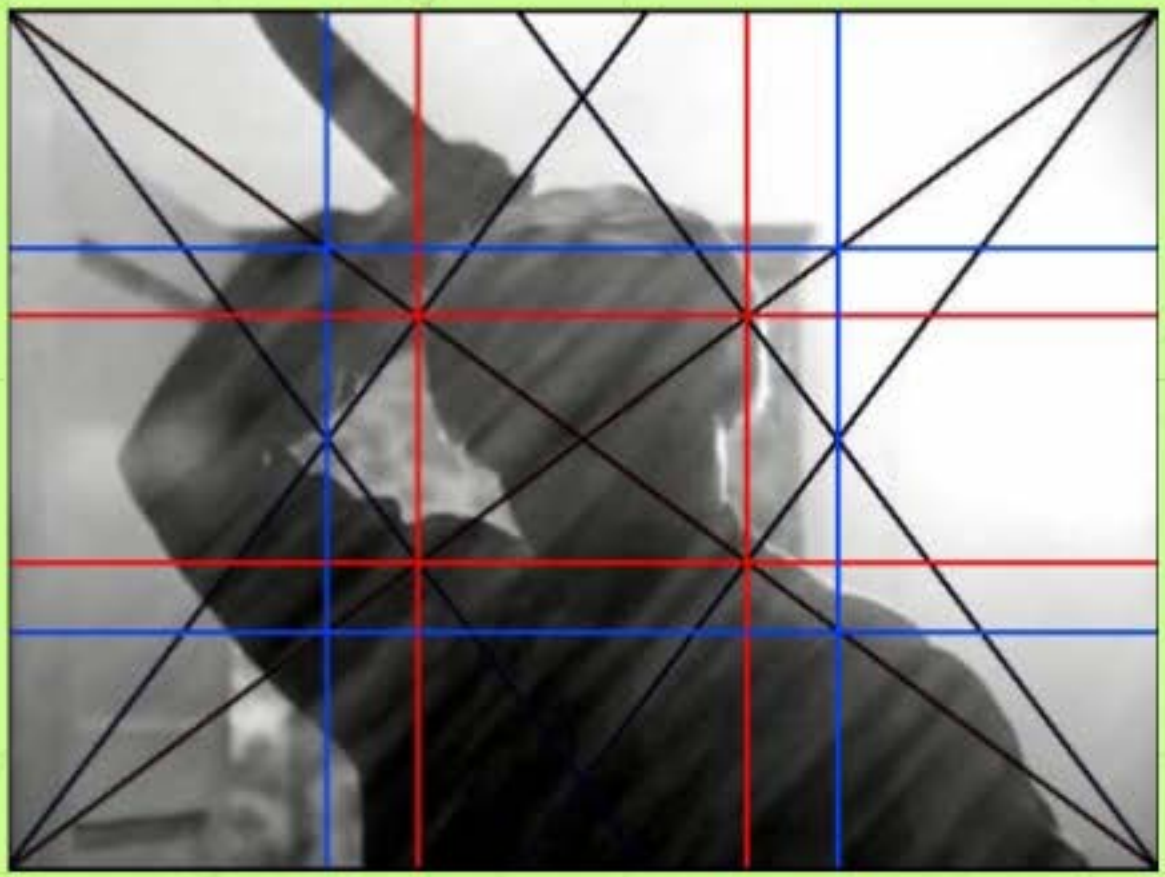
Dynamic Symmetry: Alfred Hitchcock



Position and gaze all correspond to the opposite side and direction of action from the previous cut.

(14,5,2)

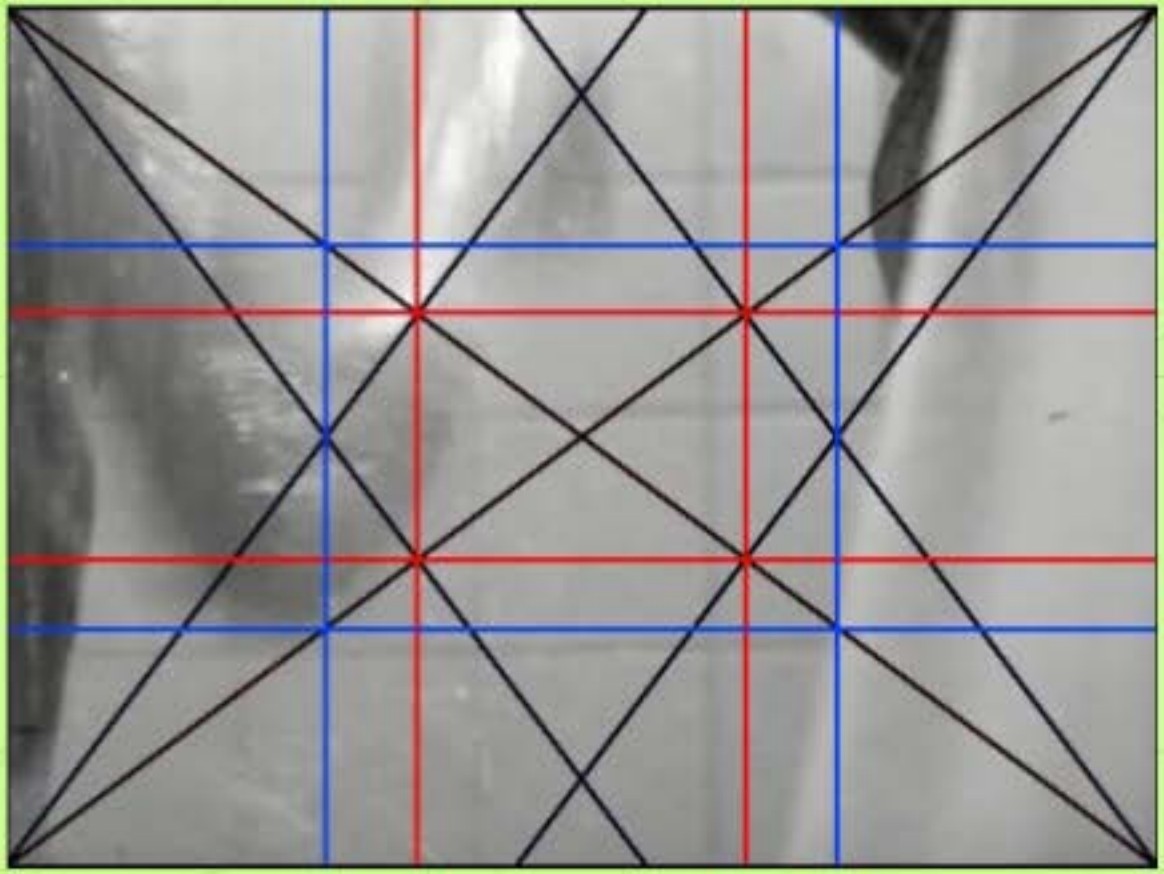
Dynamic Symmetry: Alfred Hitchcock



More angles but the alignment is off a bit.

(14,5,3)

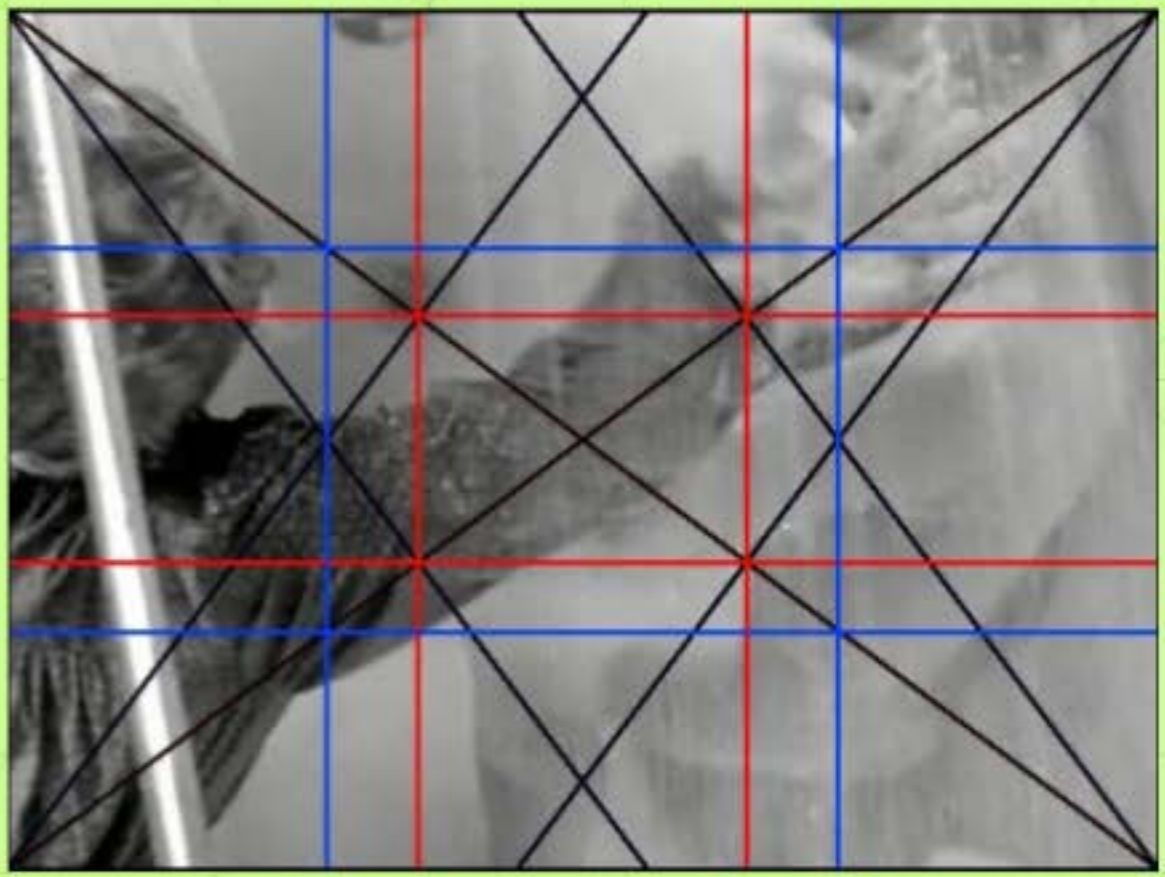
Dynamic Symmetry: Alfred Hitchcock



Blurry shot but the angles, bend and position of the arms aligns pretty well.

(15,5,3)

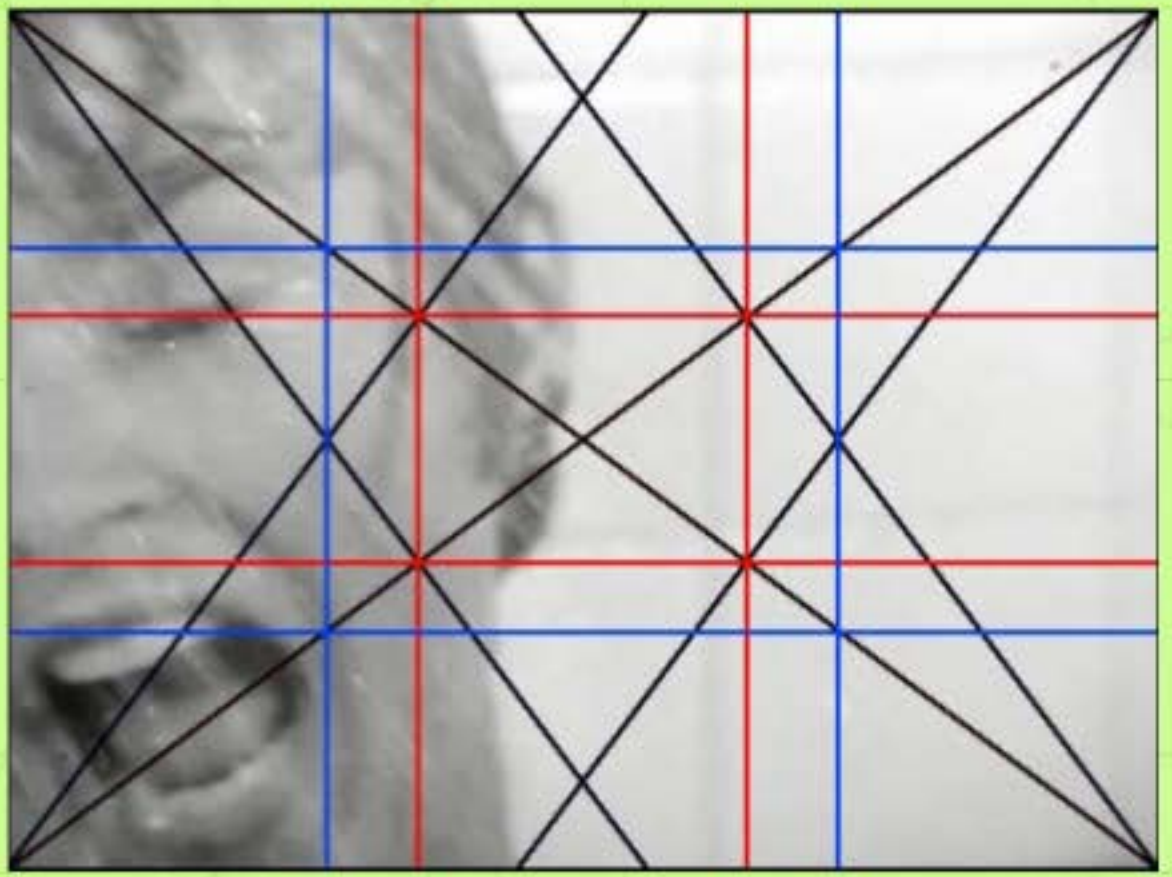
Dynamic Symmetry: Alfred Hitchcock



Considering the extreme angle and position of hands and bodies, this one aligns pretty well with the diagonals.

(16,5,3)

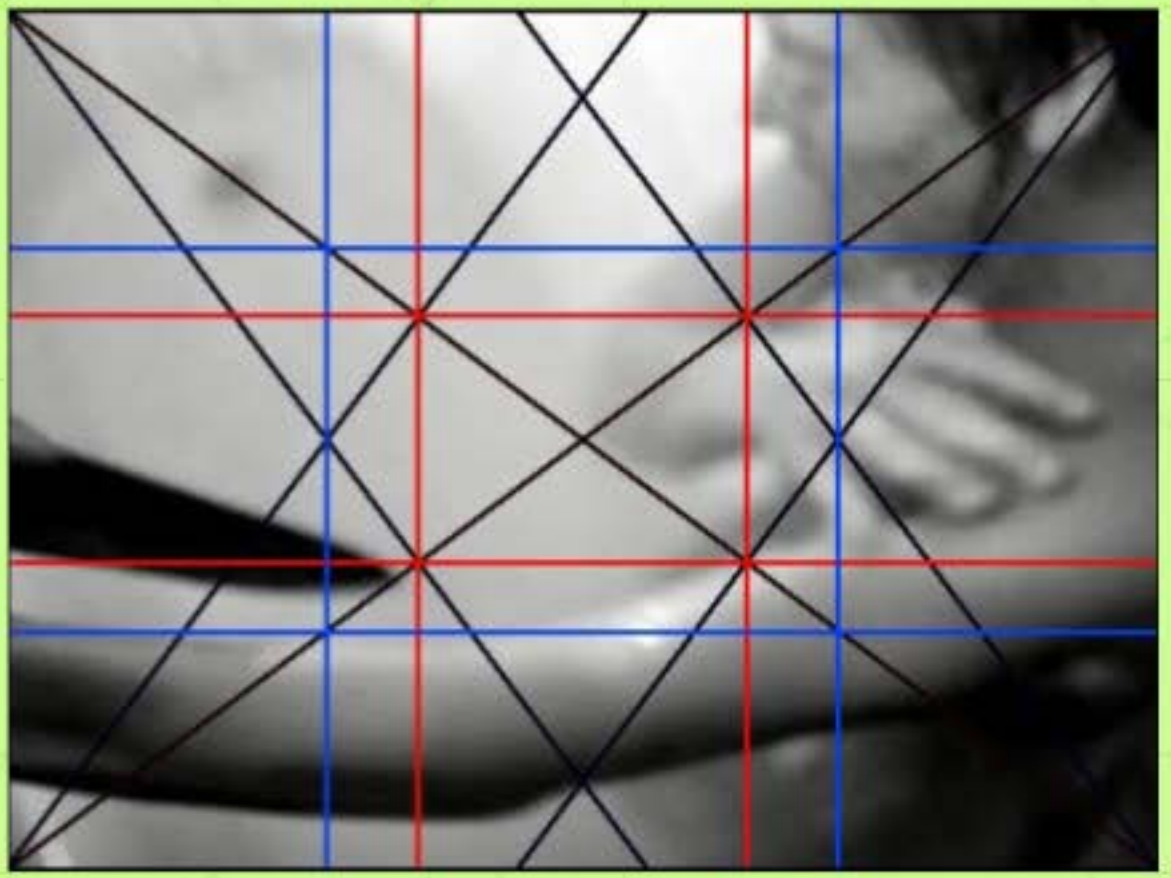
Dynamic Symmetry: Alfred Hitchcock



Perhaps only loosely aligned because of positioning.

(16,6,3)

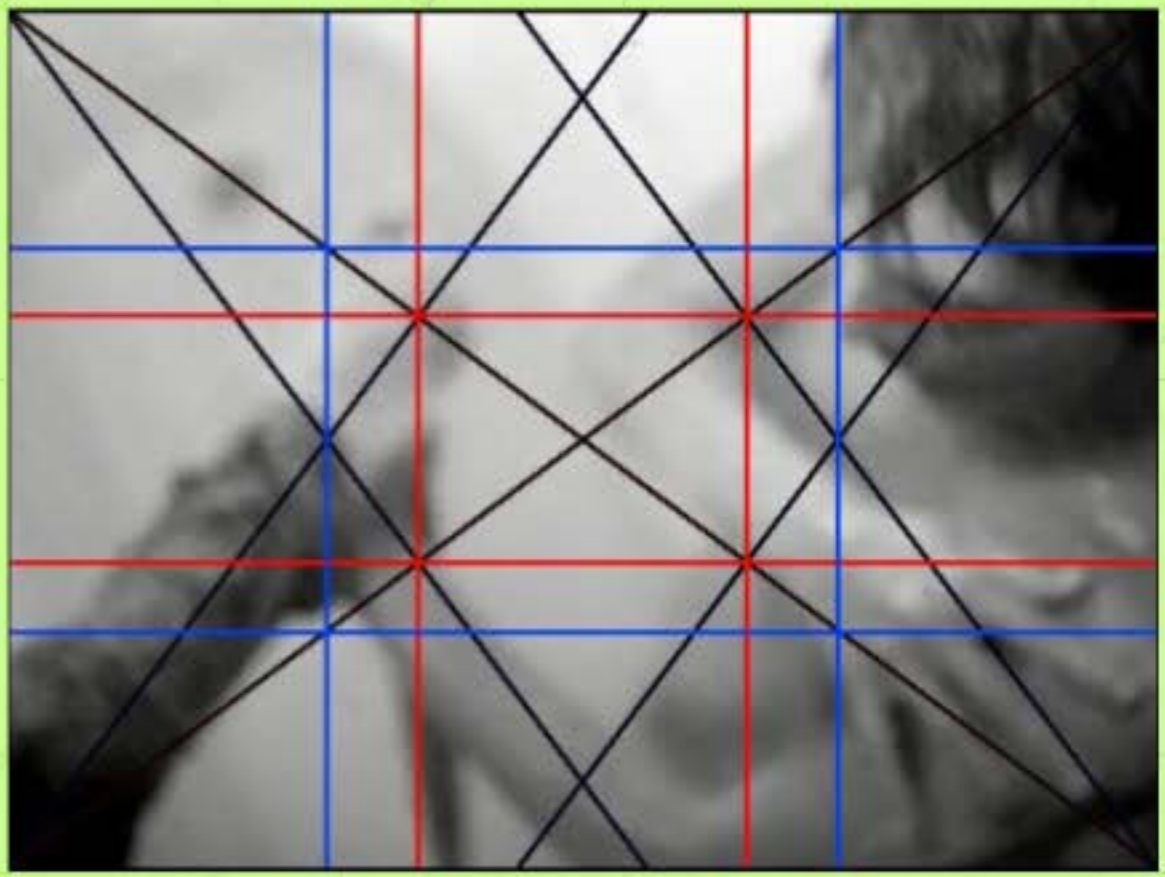
Dynamic Symmetry: Alfred Hitchcock



The angles in this shot are pretty awkward as a pose, but they align well.

(17,6,3)

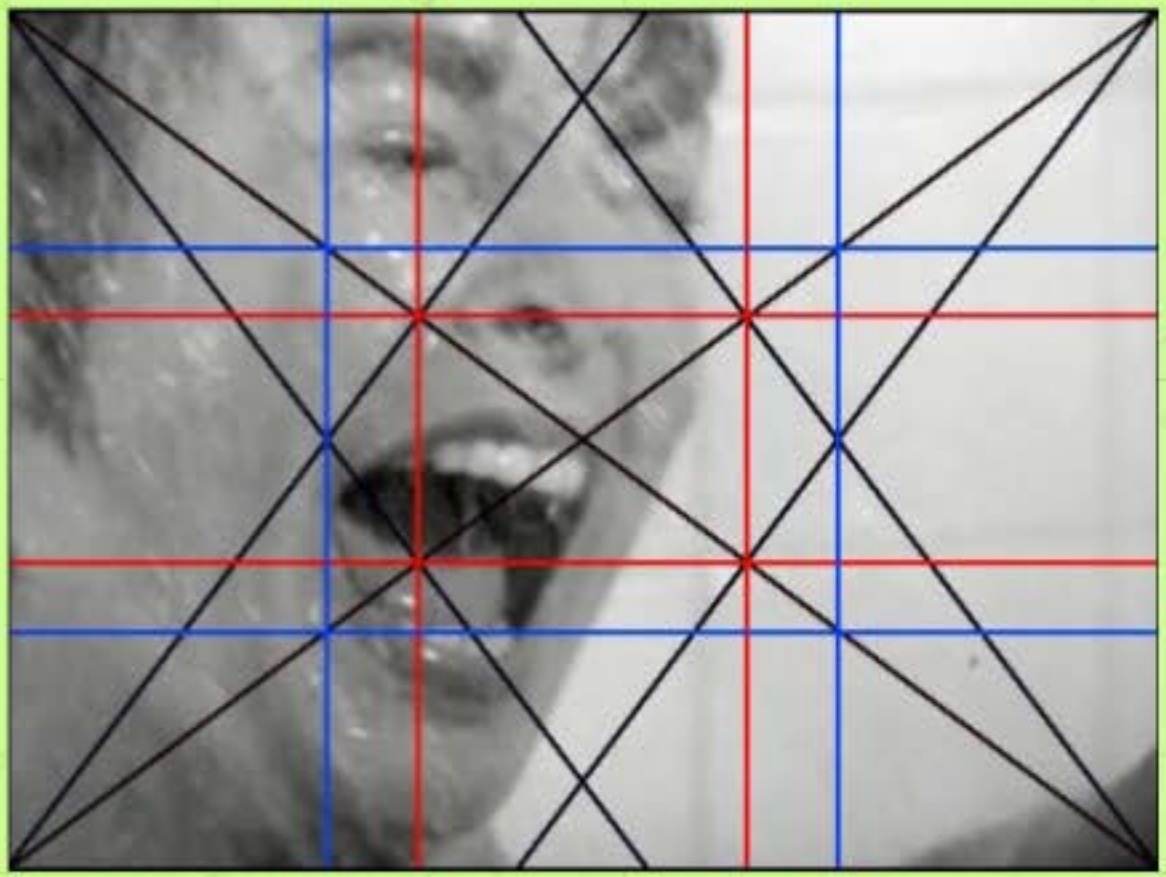
Dynamic Symmetry: Alfred Hitchcock



The zigzagging and interaction between the hands is pretty spot on.

(18,6,3)

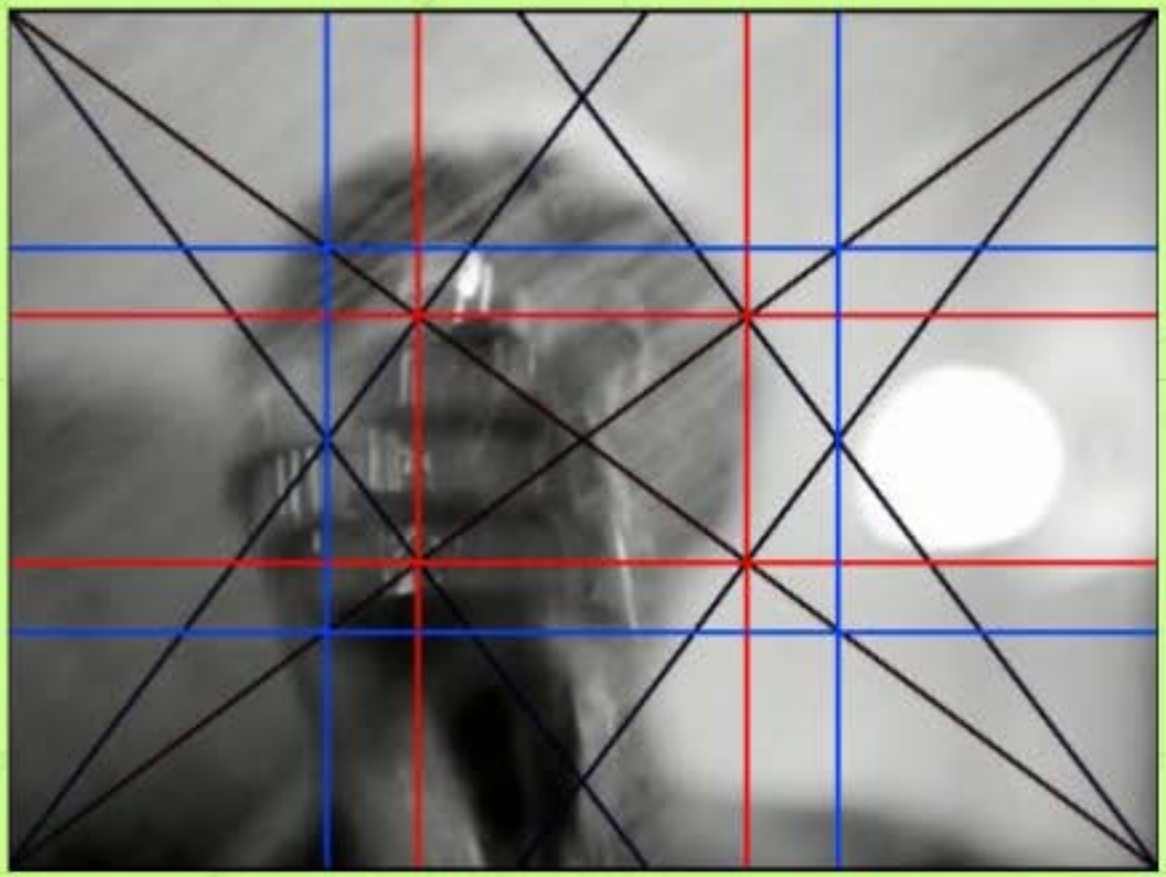
Dynamic Symmetry: Alfred Hitchcock



Loose alignment. This happens more on extreme closeups where there is less to work with in the position of parts on the face.

(18,7,3)

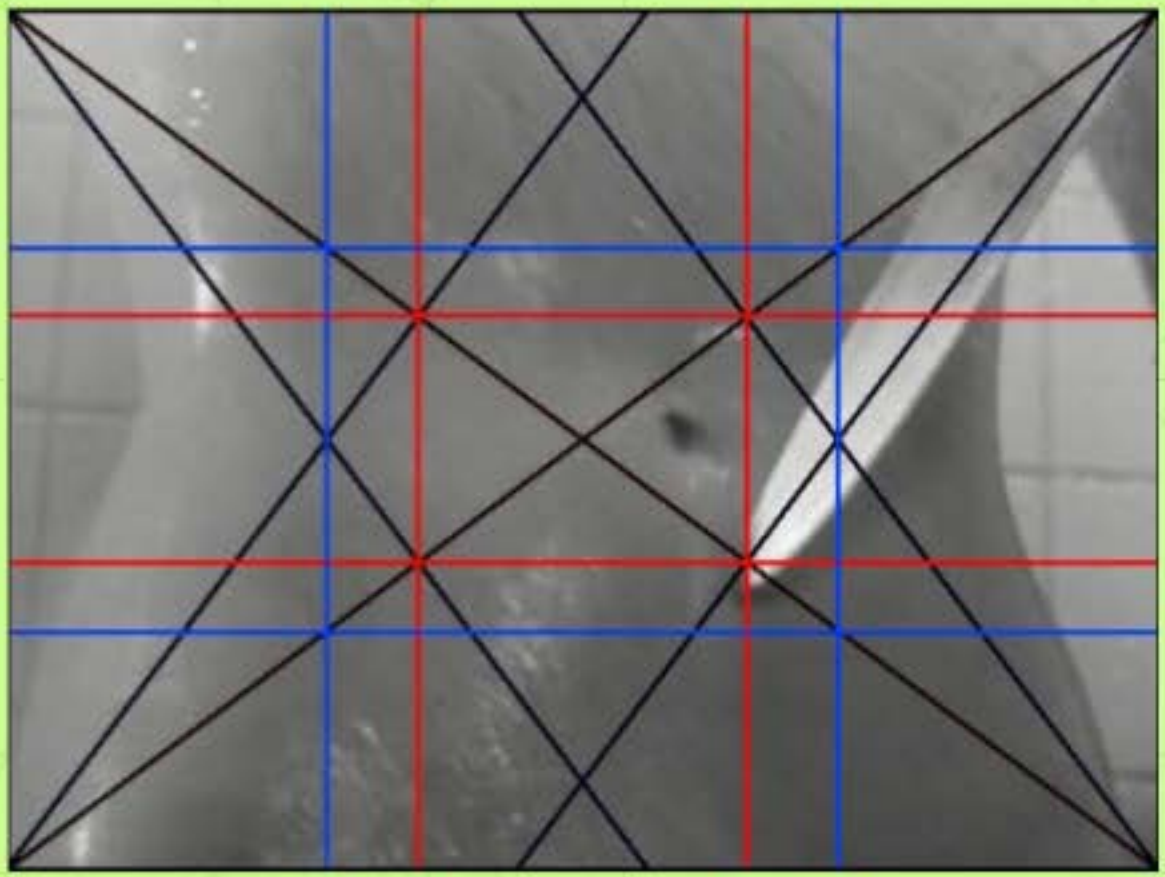
Dynamic Symmetry: Alfred Hitchcock



Loose alignment again. Thoud the direction of slashing is pretty spot on the eye lines.

(18,8,3)

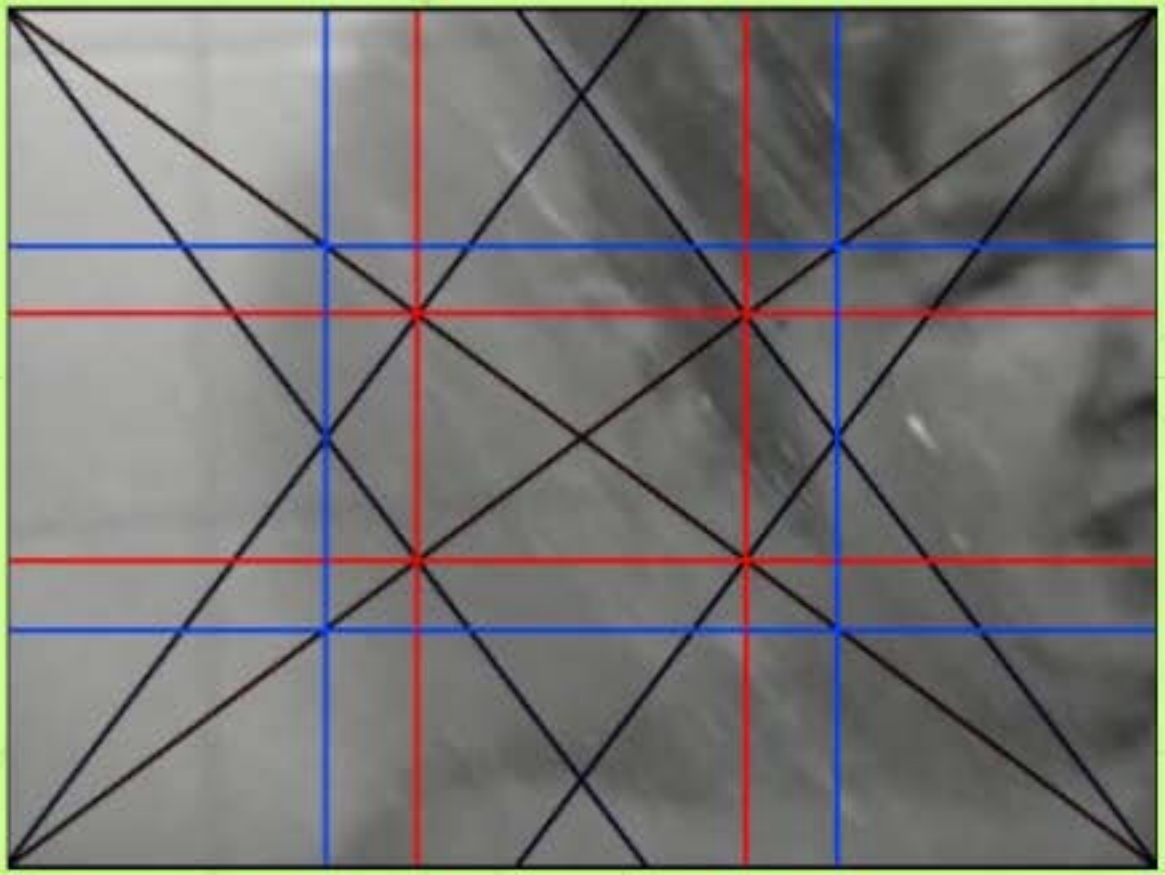
Dynamic Symmetry: Alfred Hitchcock



The dagger angle and end point is pretty convincing.

(19,8,3)

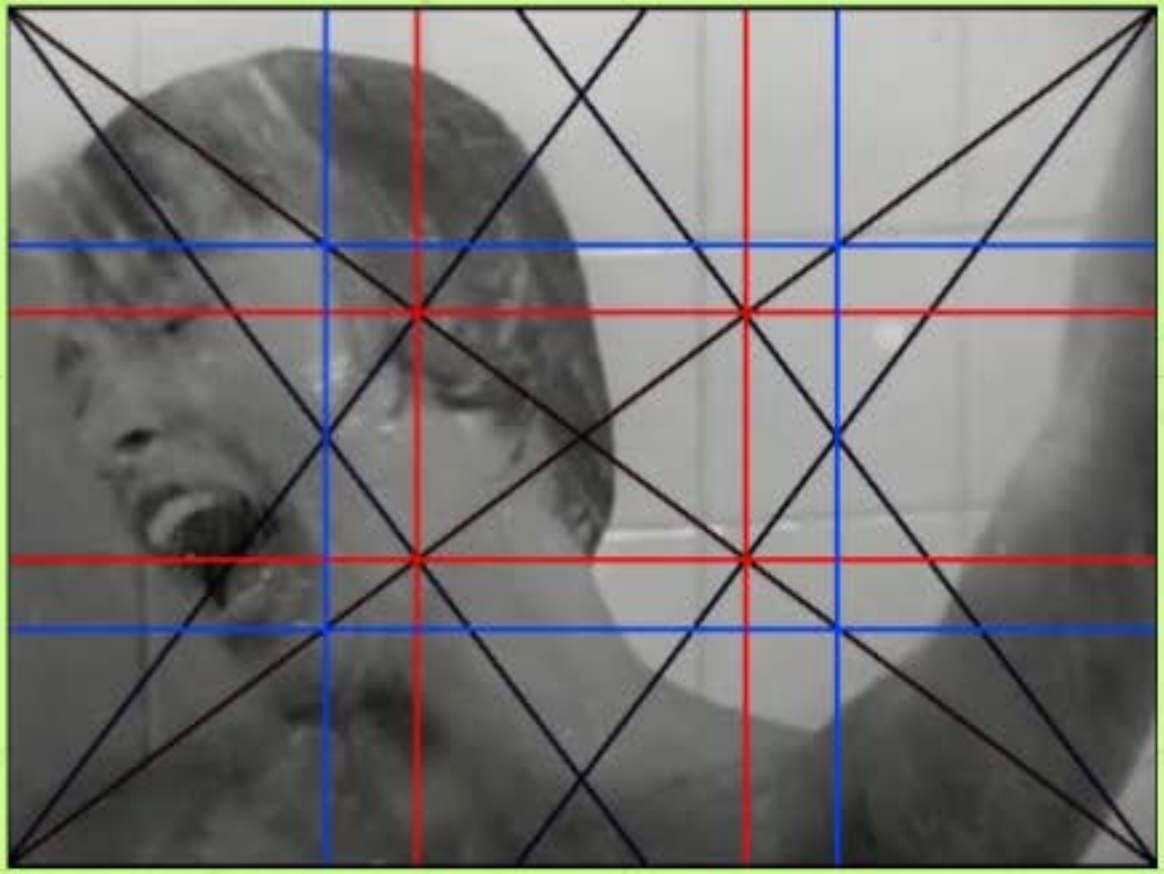
Dynamic Symmetry: Alfred Hitchcock



Loose thanks to the closeup.

(19,9,3)

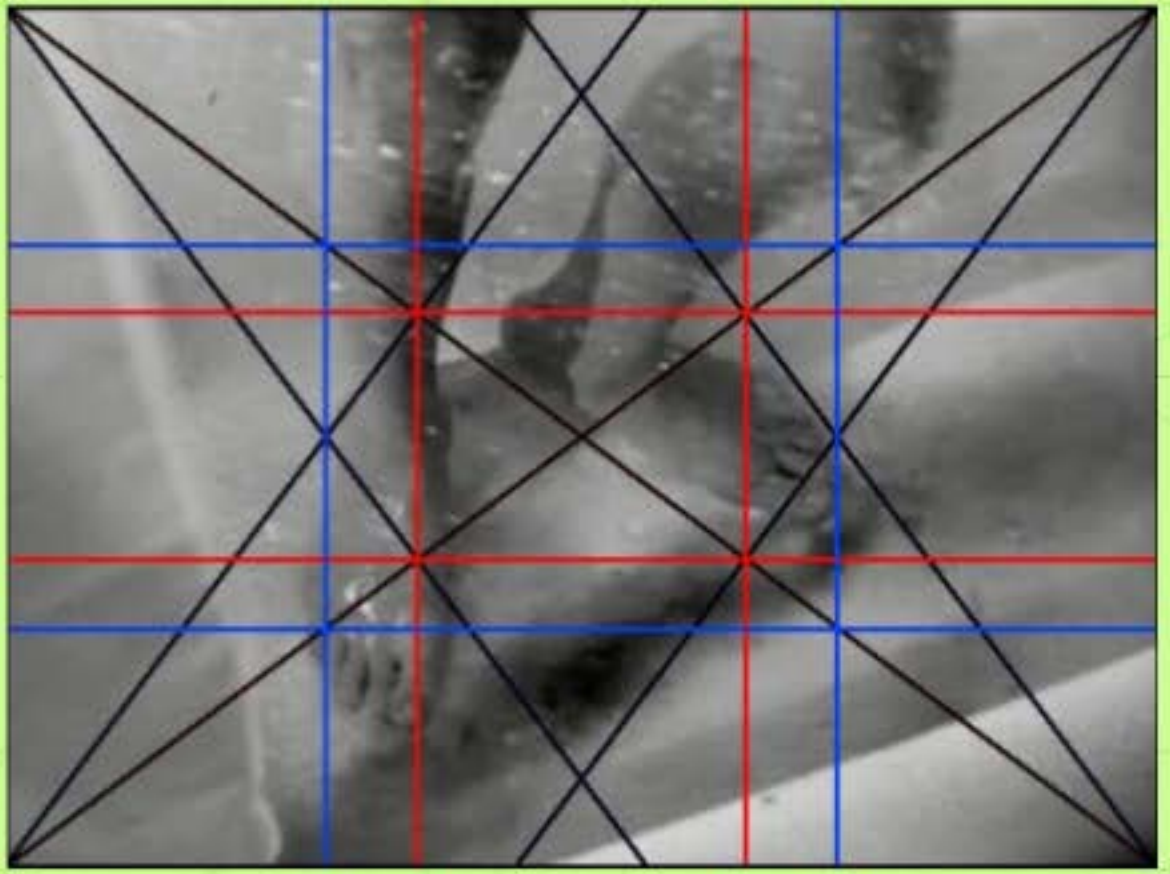
Dynamic Symmetry: Alfred Hitchcock



Back to to strong. The back and forth between loose and strong grid alignment and expectation with placement of objects from one cut to the other starts to resemble a dance.

(20,9,3)

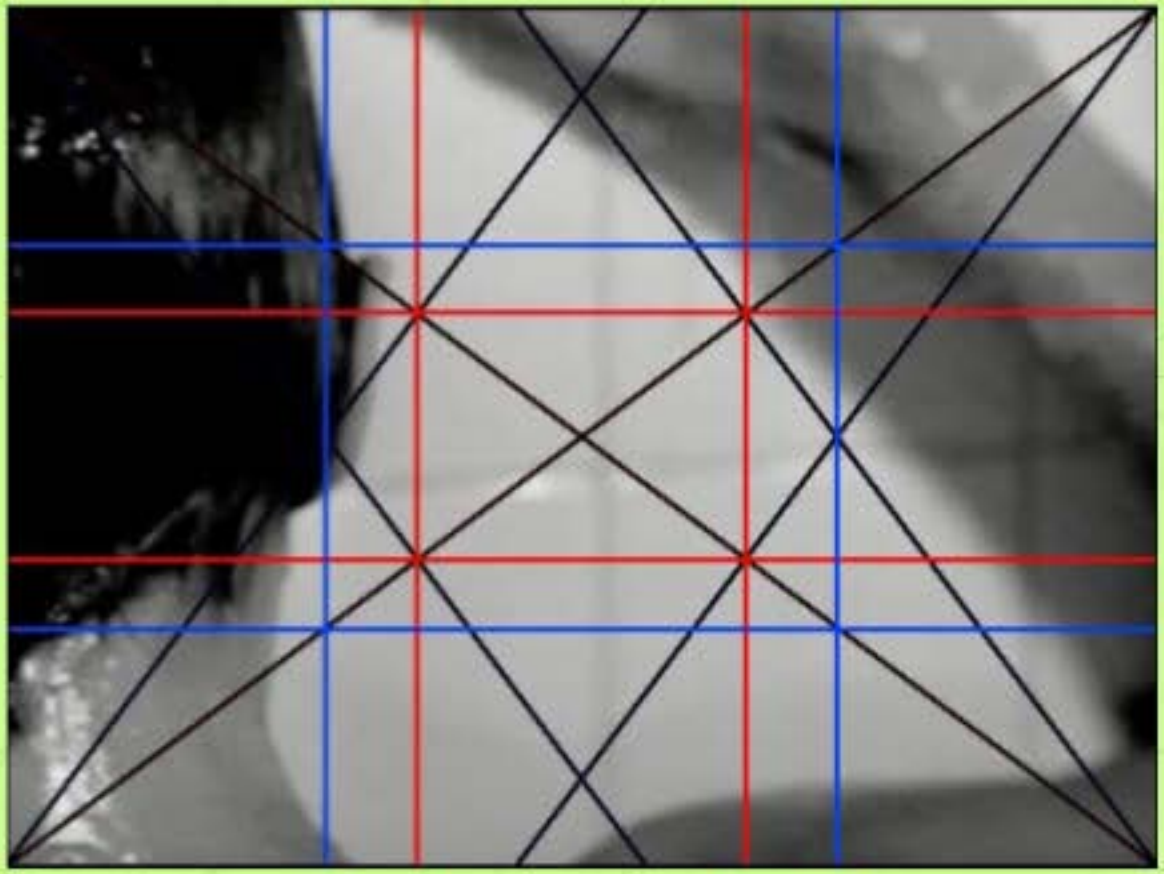
Dynamic Symmetry: Alfred Hitchcock



Loosish for the sake of argument.

(20,10,3)

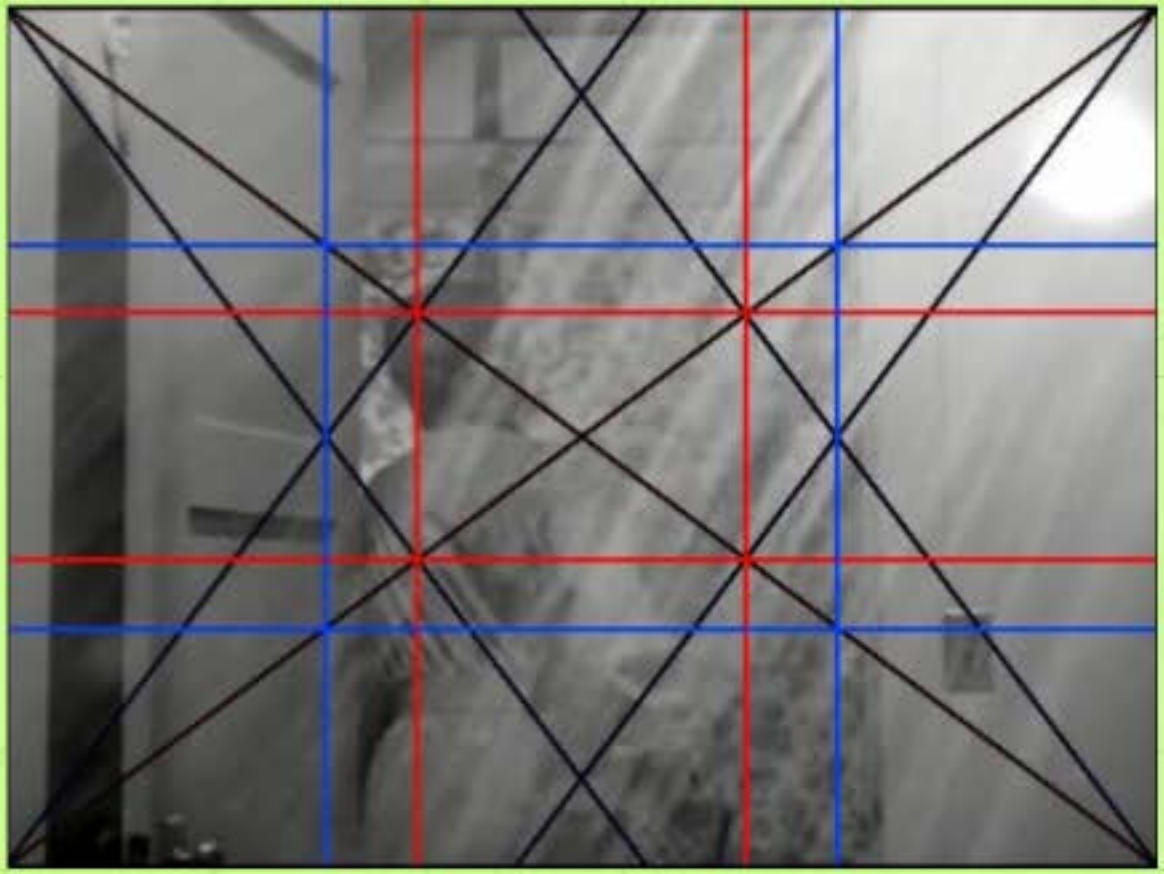
Dynamic Symmetry: Alfred Hitchcock



Strong alignment thanks to the shadow.

(21,10,3)

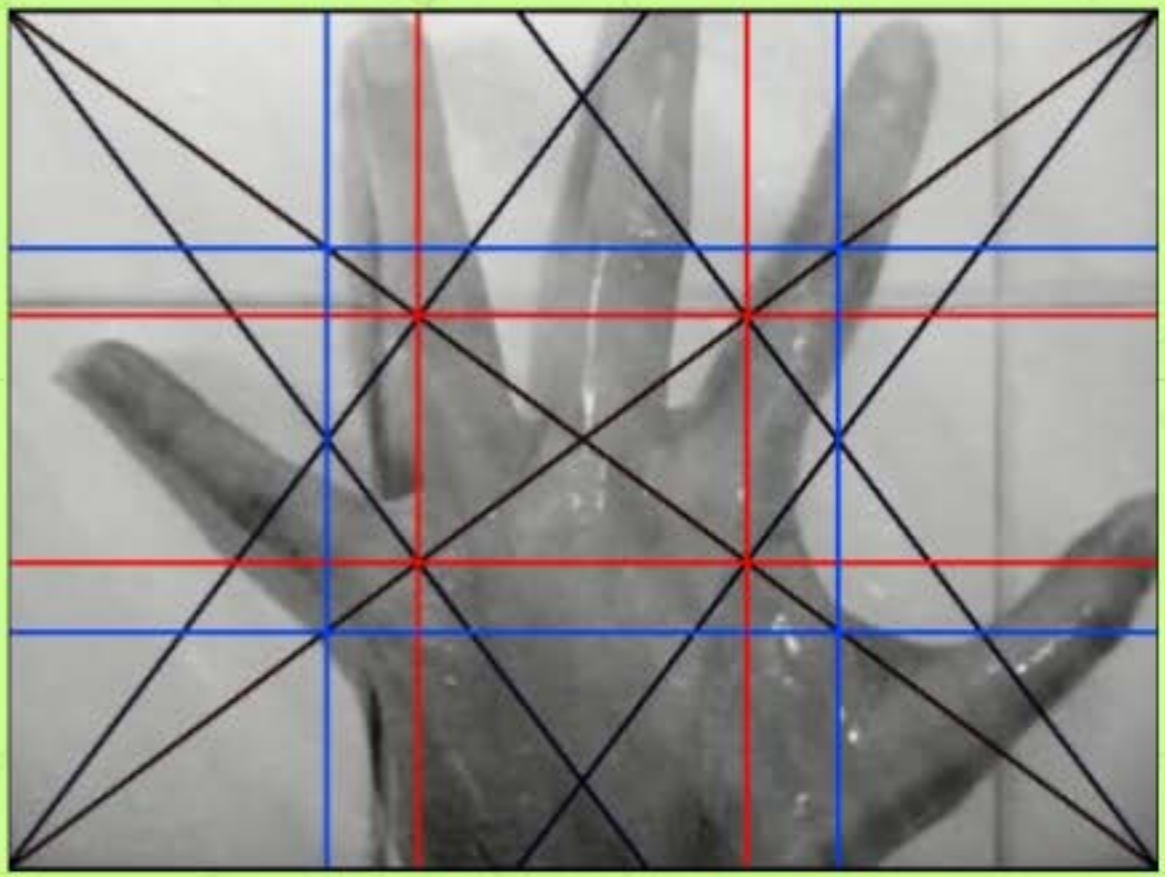
Dynamic Symmetry: Alfred Hitchcock



Norman leaves. Even the shadow of the door at the top left aligns.

(22,10,3)

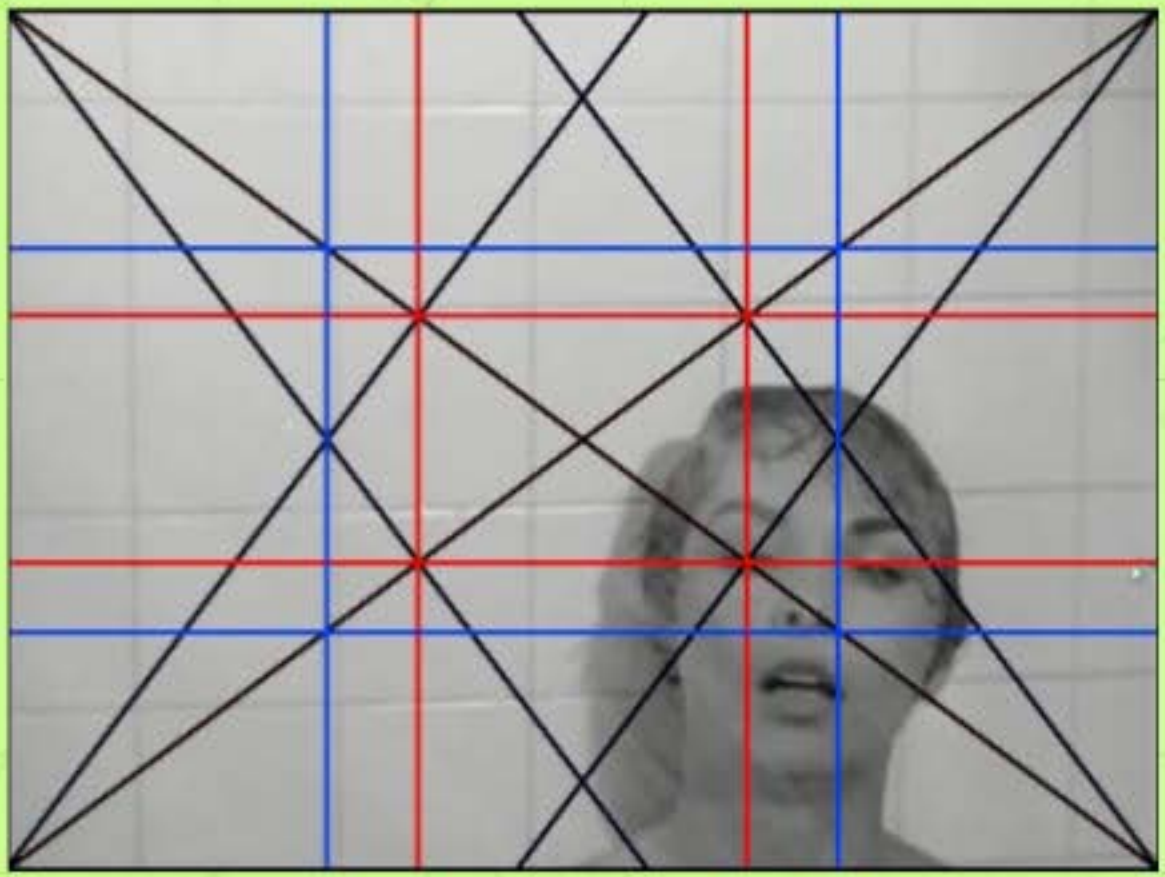
Dynamic Symmetry: Alfred Hitchcock



Even with all of the grid alignment and positioning, the hand is just too big to consider it aligned with anything except the center.

(22,10,4)

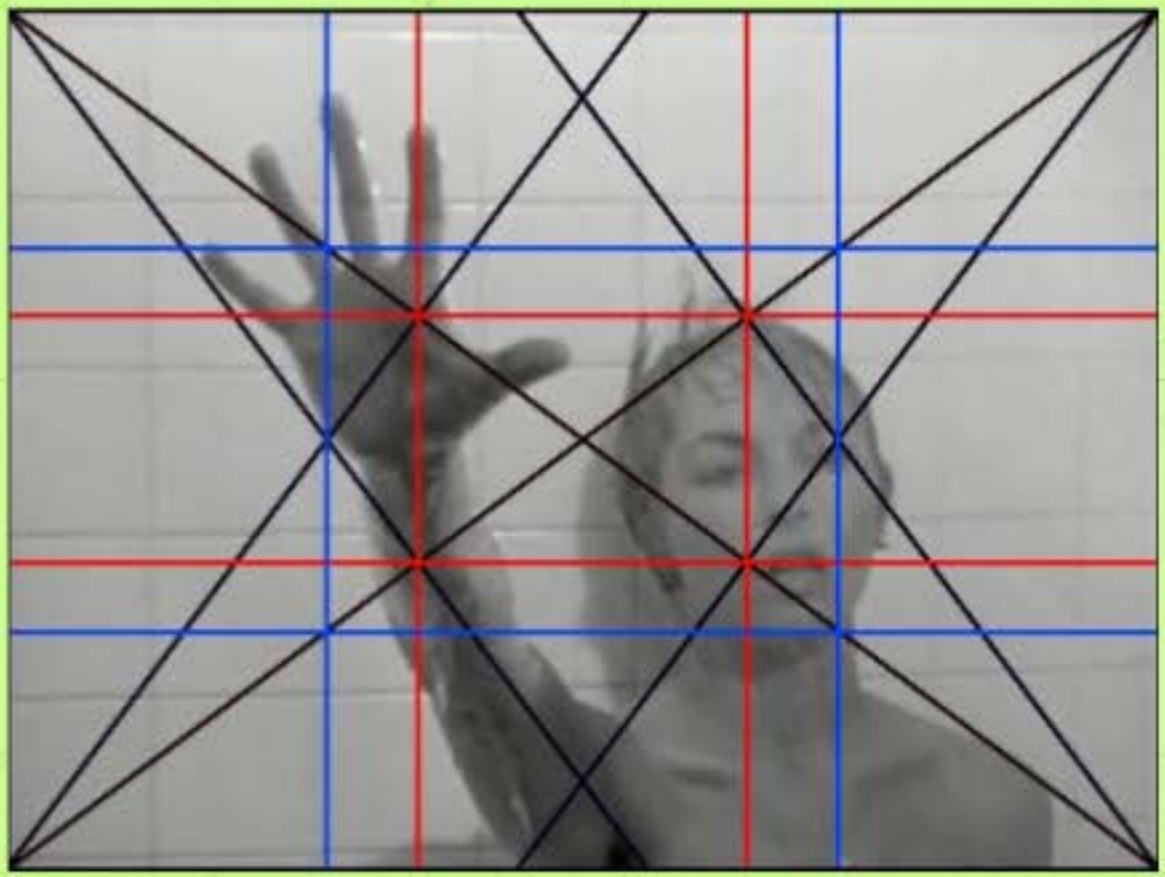
Dynamic Symmetry: Alfred Hitchcock



On the other hand this one is spot on.

(23,10,4)

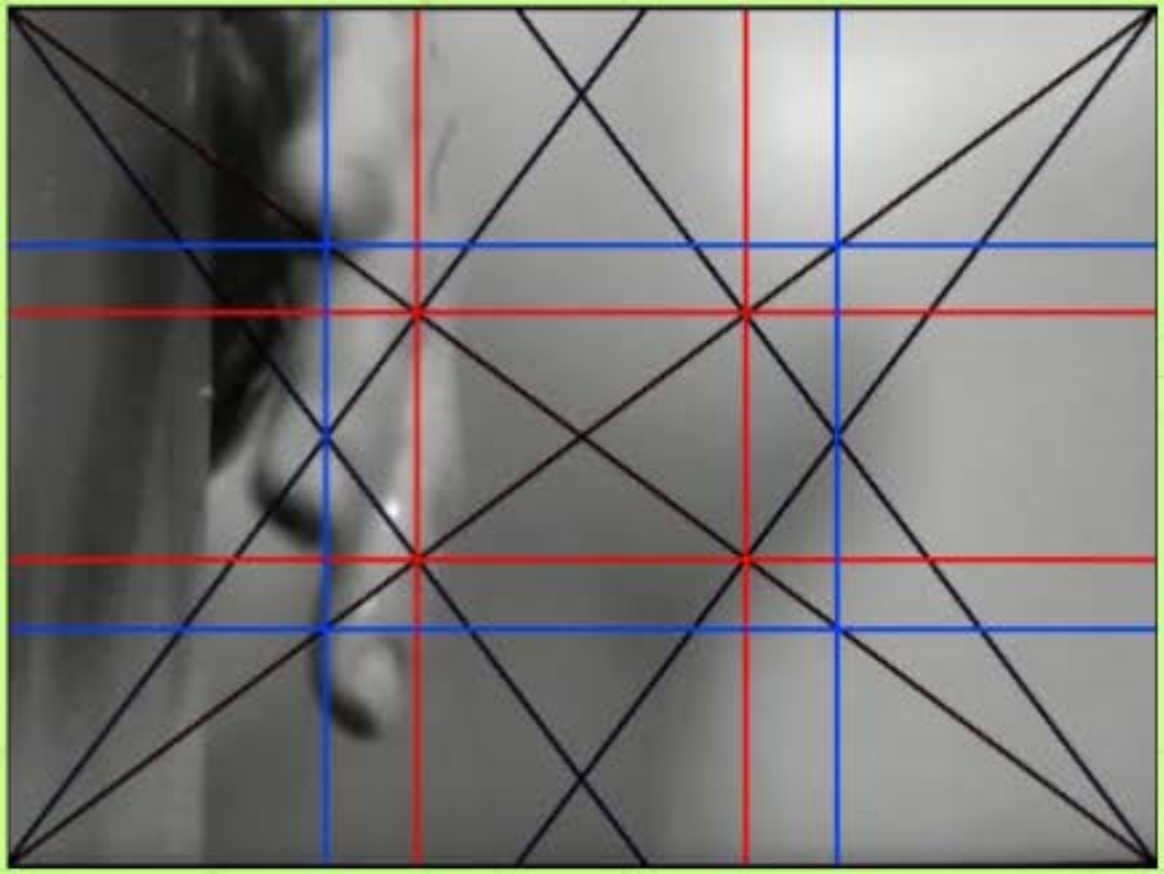
Dynamic Symmetry: Alfred Hitchcock



Hands eyes and angles.

(24,10,4)

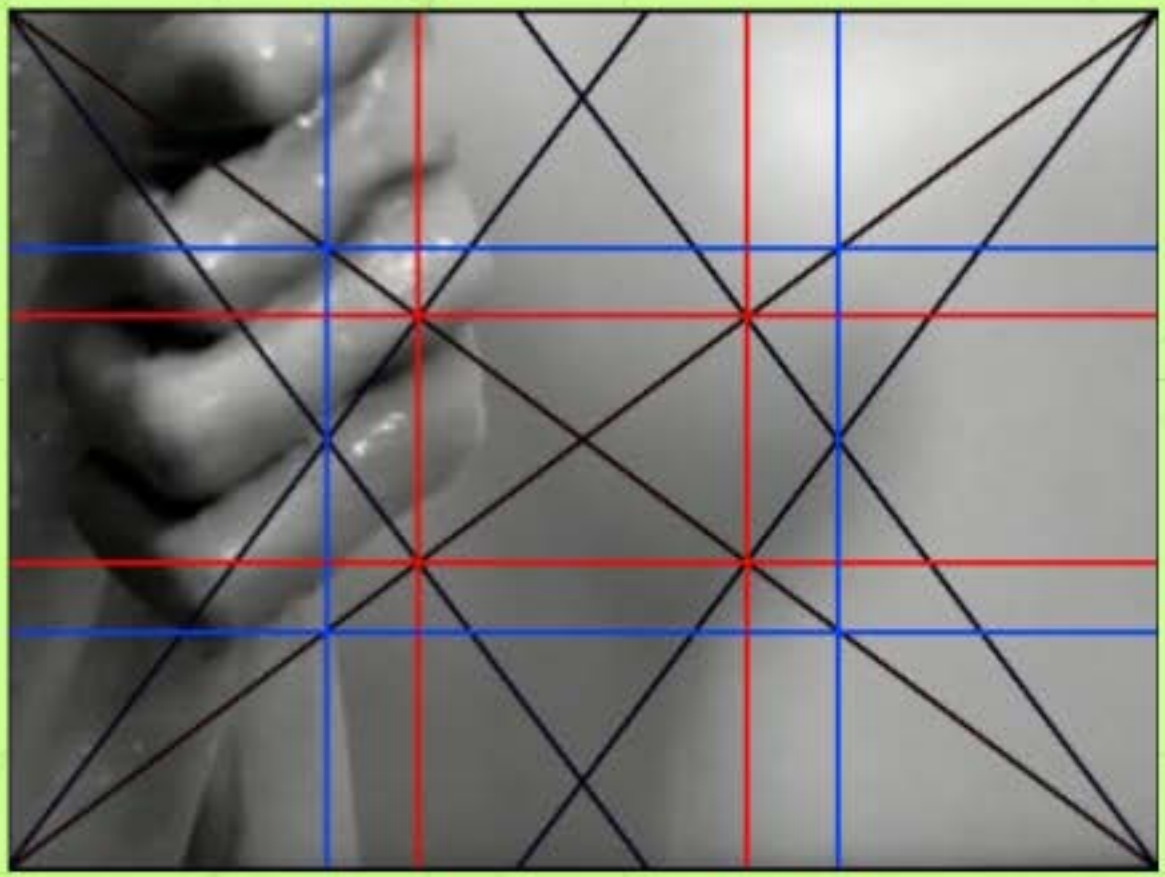
Dynamic Symmetry: Alfred Hitchcock



Loose at best thanks to the close up.

(24,11,4)

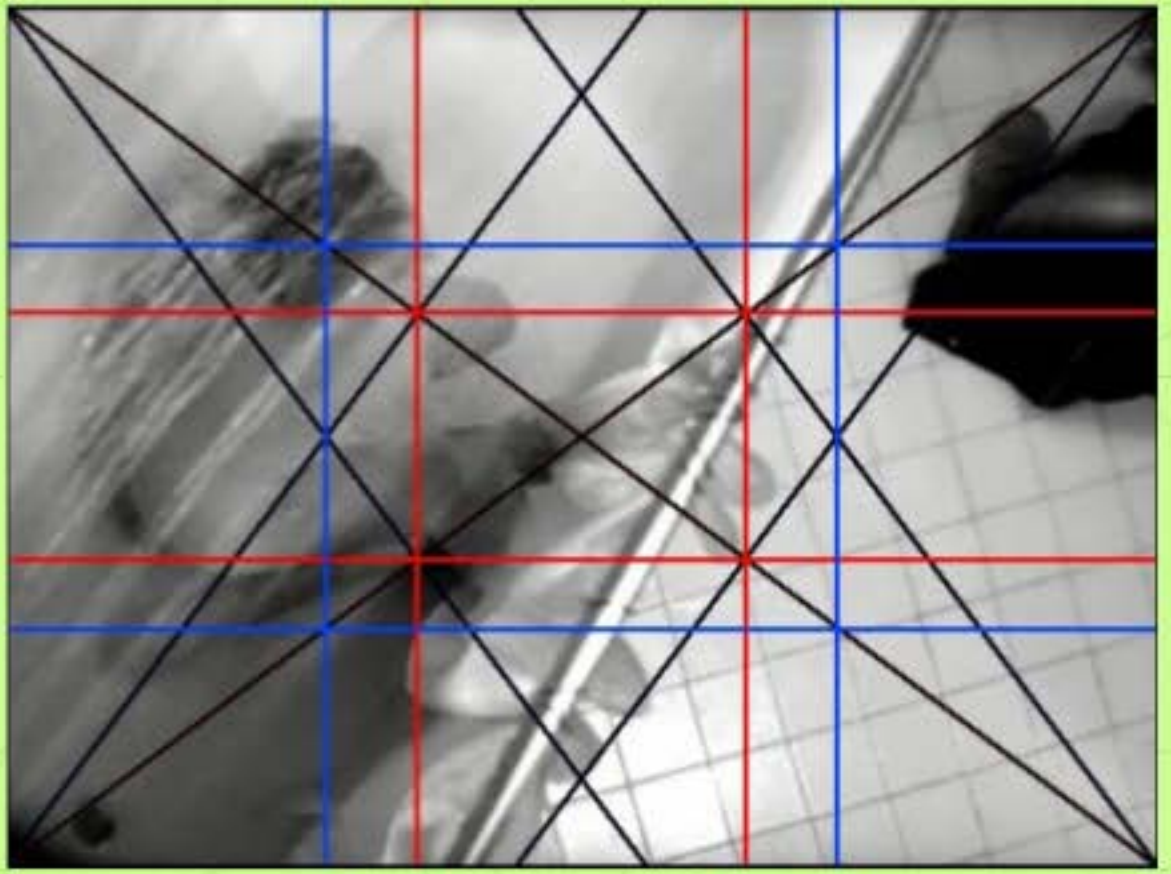
Dynamic Symmetry: Alfred Hitchcock



Loose at best thanks to the close up.

(24,12,4)

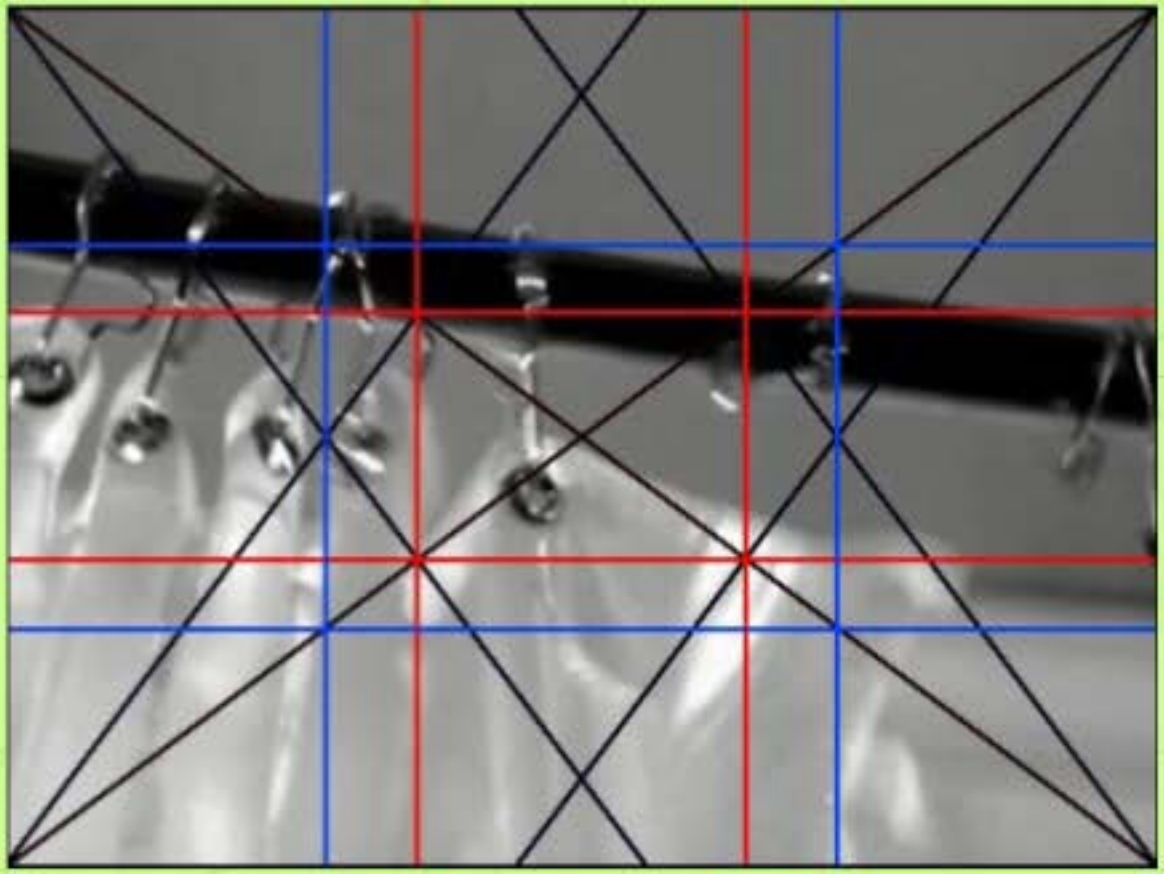
Dynamic Symmetry: Alfred Hitchcock



Another extreme angle, but the diagonals are pretty spot on with the intersections.

(25,12,4)

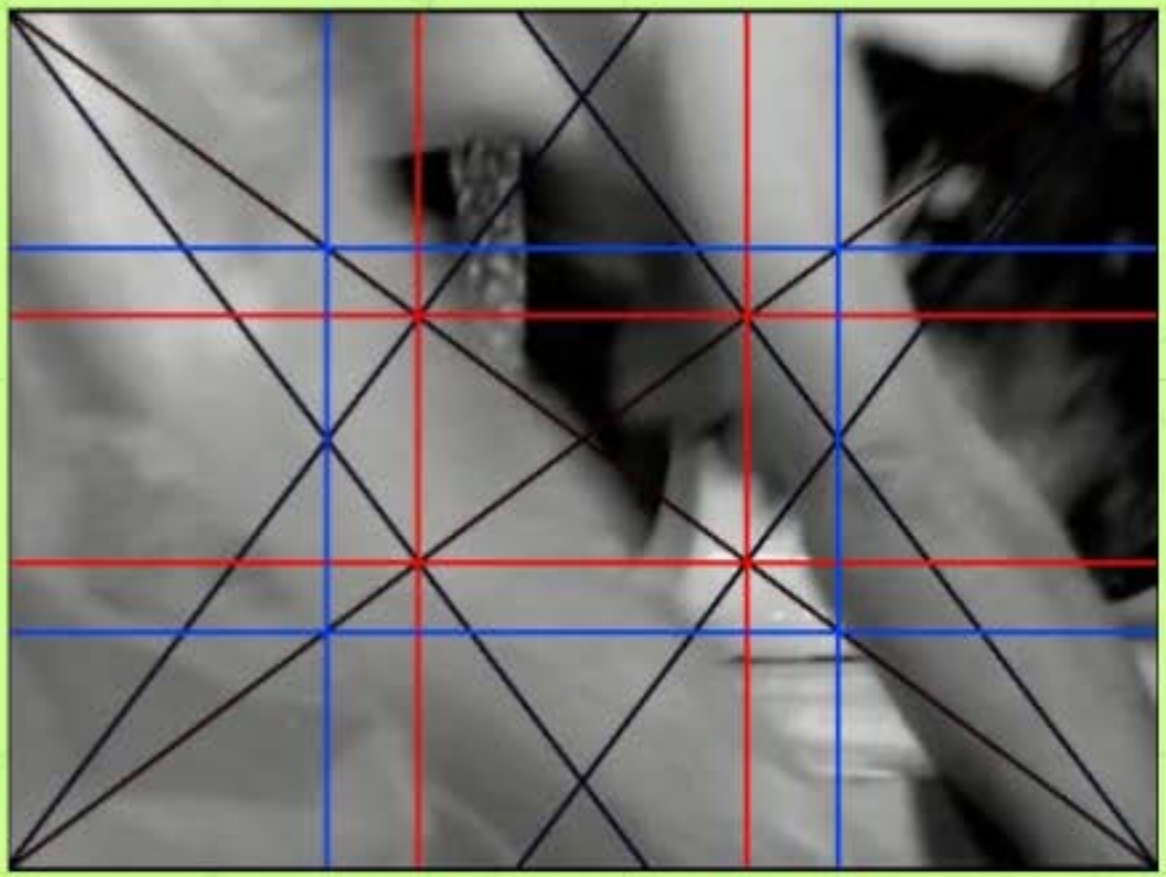
Dynamic Symmetry: Alfred Hitchcock



Not so much do the the lack of a focal point other than the line of action.

(25,12,5)

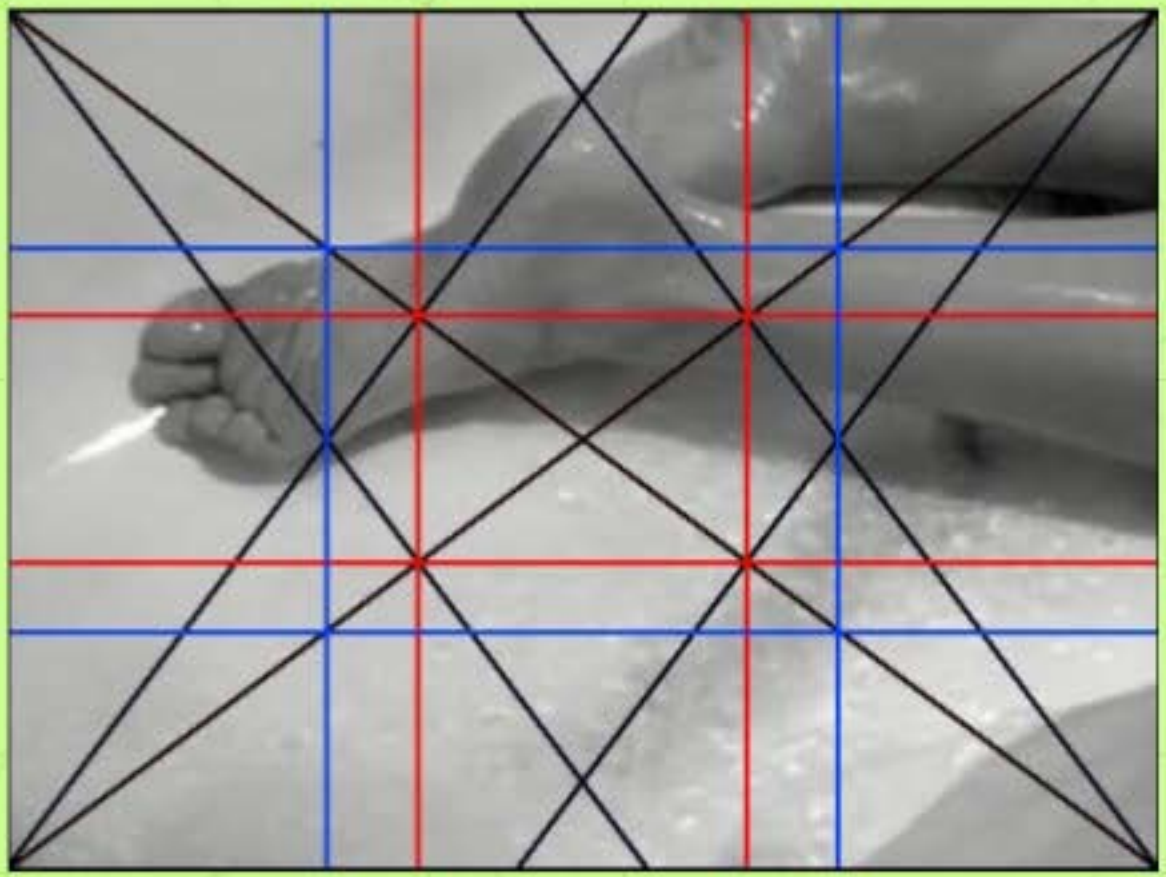
Dynamic Symmetry: Alfred Hitchcock



Leg and arm. I'll call it a loose match.

(25,13,5)

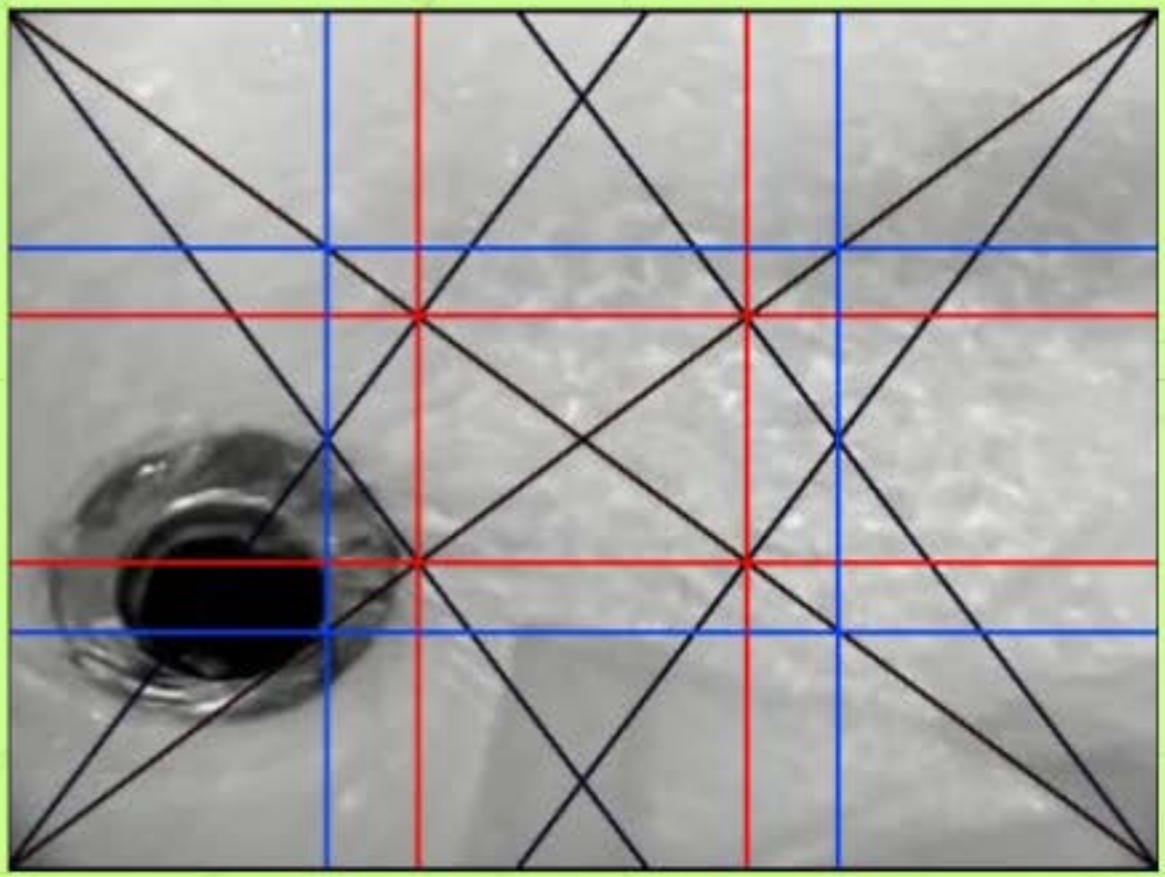
Dynamic Symmetry: Alfred Hitchcock



Only loosely aligned.

(25,14,5)

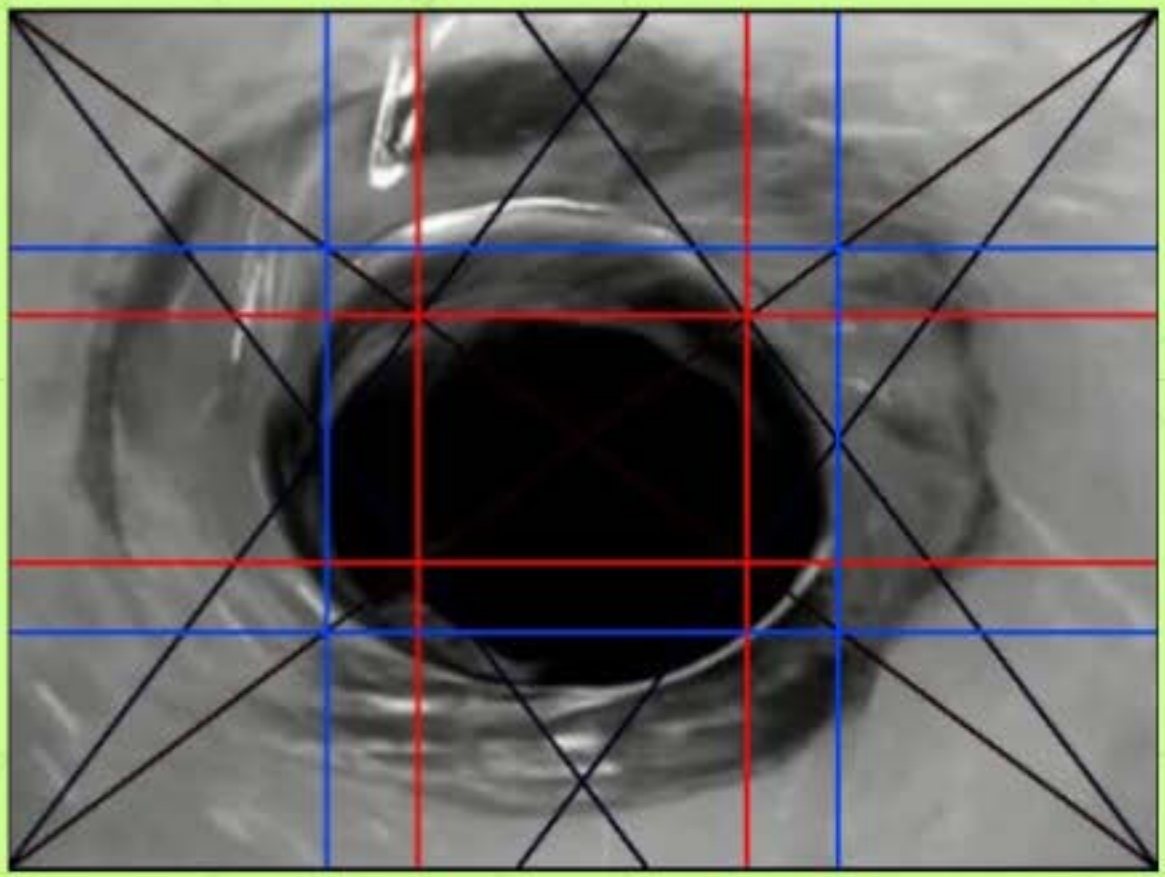
Dynamic Symmetry: Alfred Hitchcock



Positioned at the lower eye intersects.

(26,14,5)

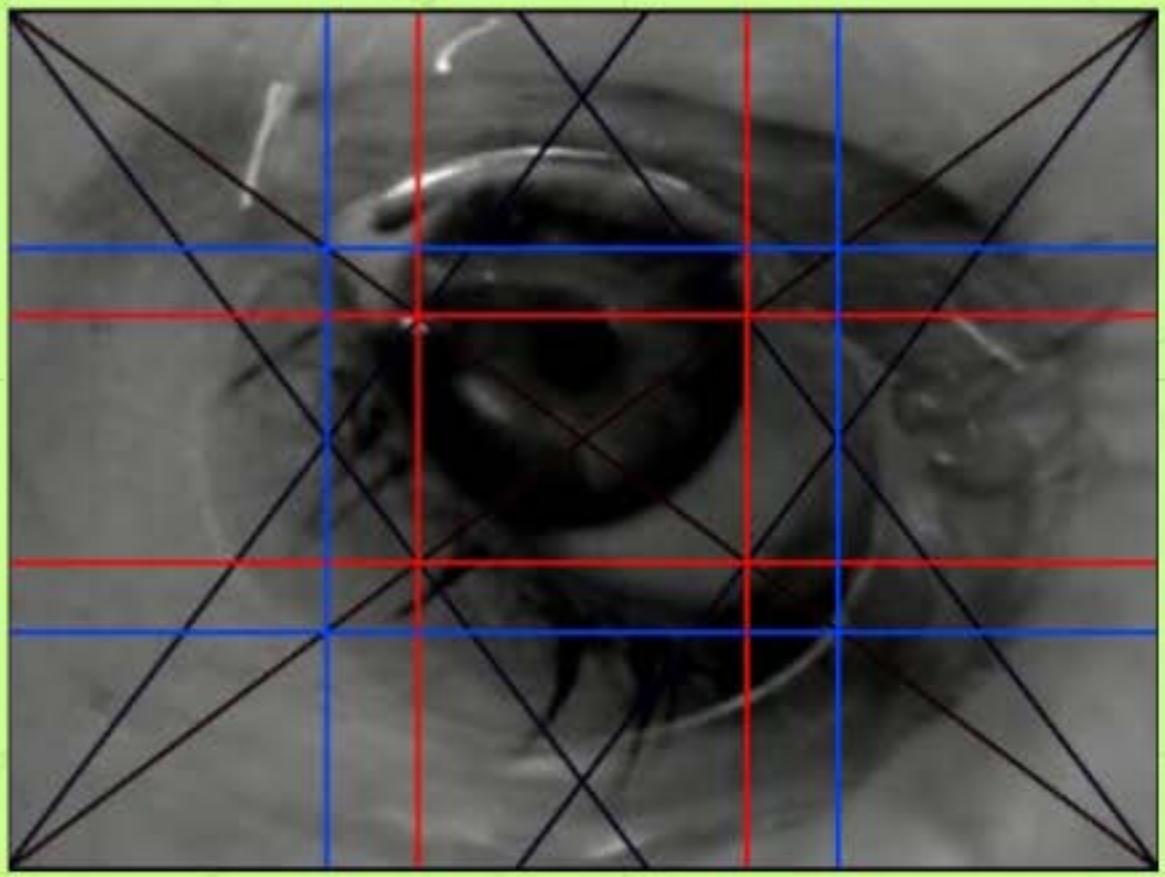
Dynamic Symmetry: Alfred Hitchcock



Pretty centered.

(26,14,6)

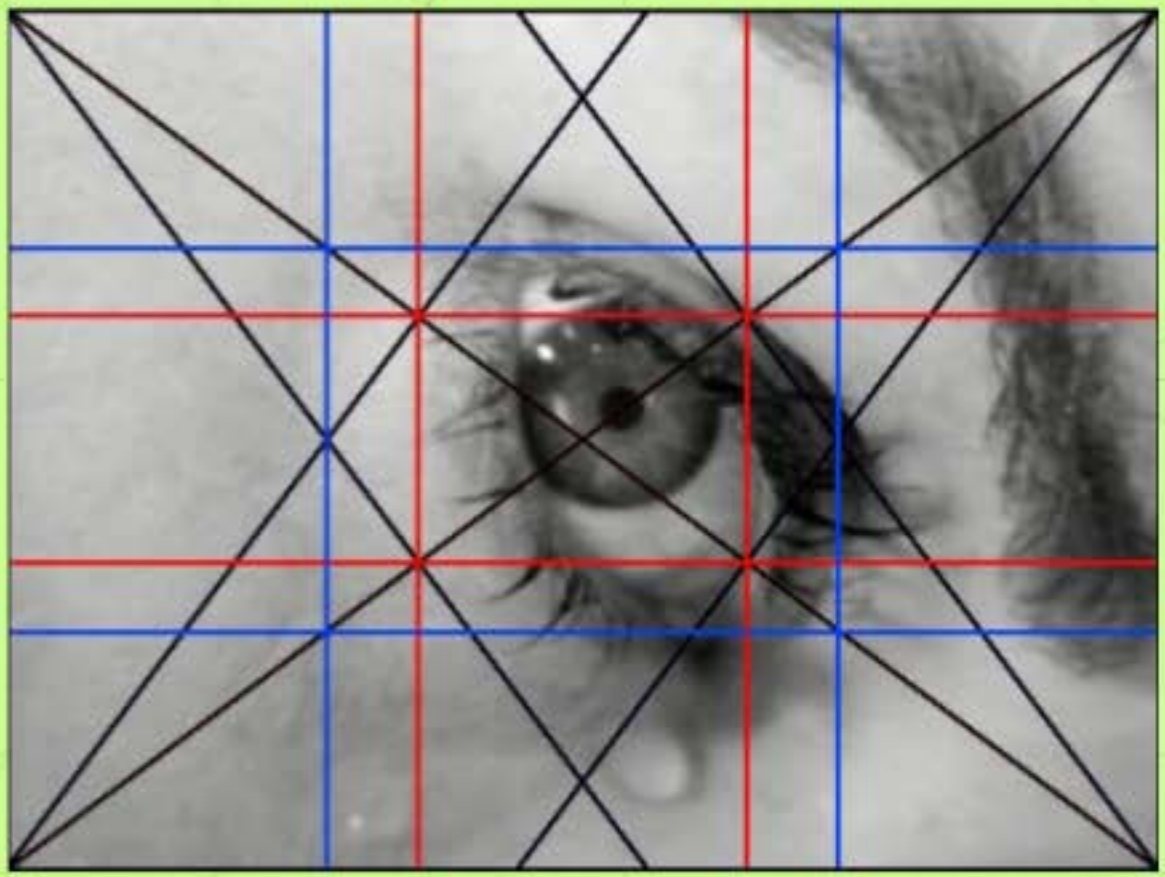
Dynamic Symmetry: Alfred Hitchcock



Pretty centered.

(26,14,7)

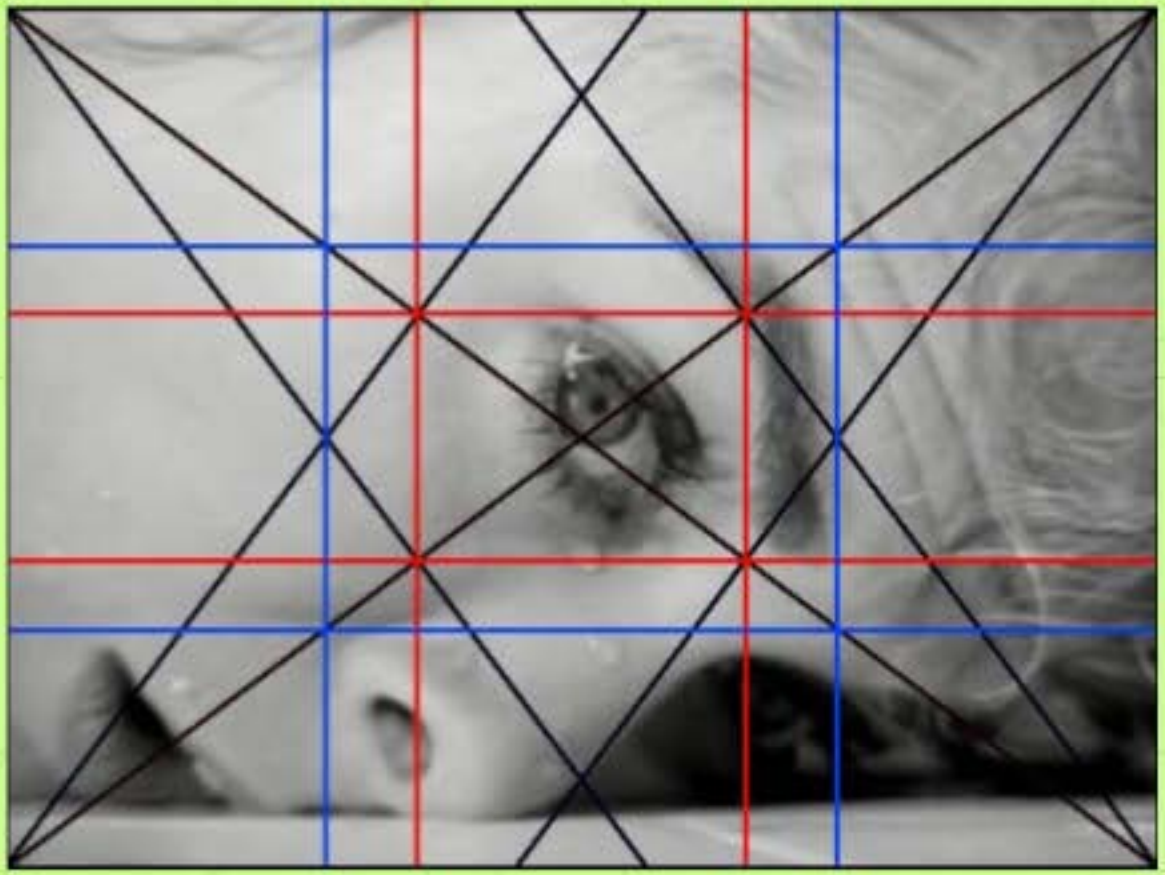
Dynamic Symmetry: Alfred Hitchcock



Pretty centered. Since its zooming and not cutting I'll only count it once.

(26,14,7)

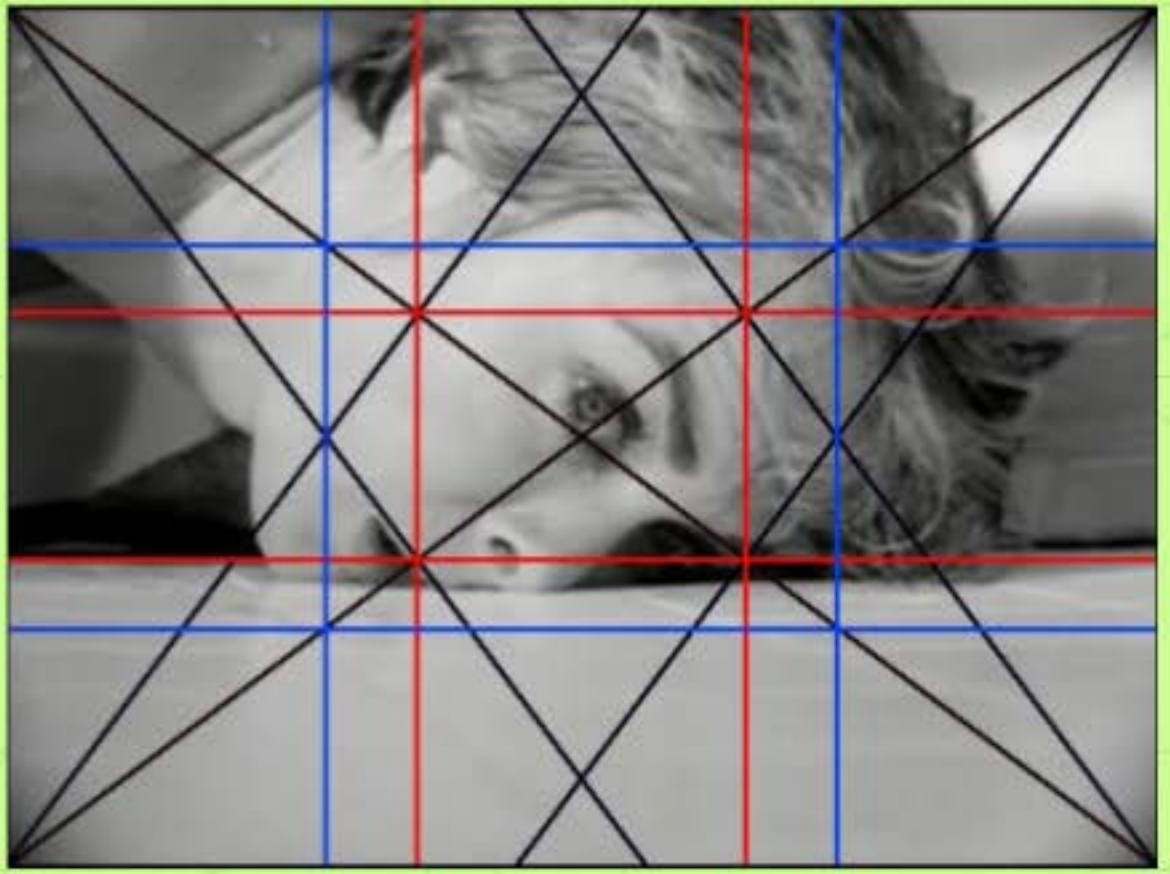
Dynamic Symmetry: Alfred Hitchcock



The eye to mouth line is pretty diagonal as well as the eyebrow.

(27,14,7)

Dynamic Symmetry: Alfred Hitchcock

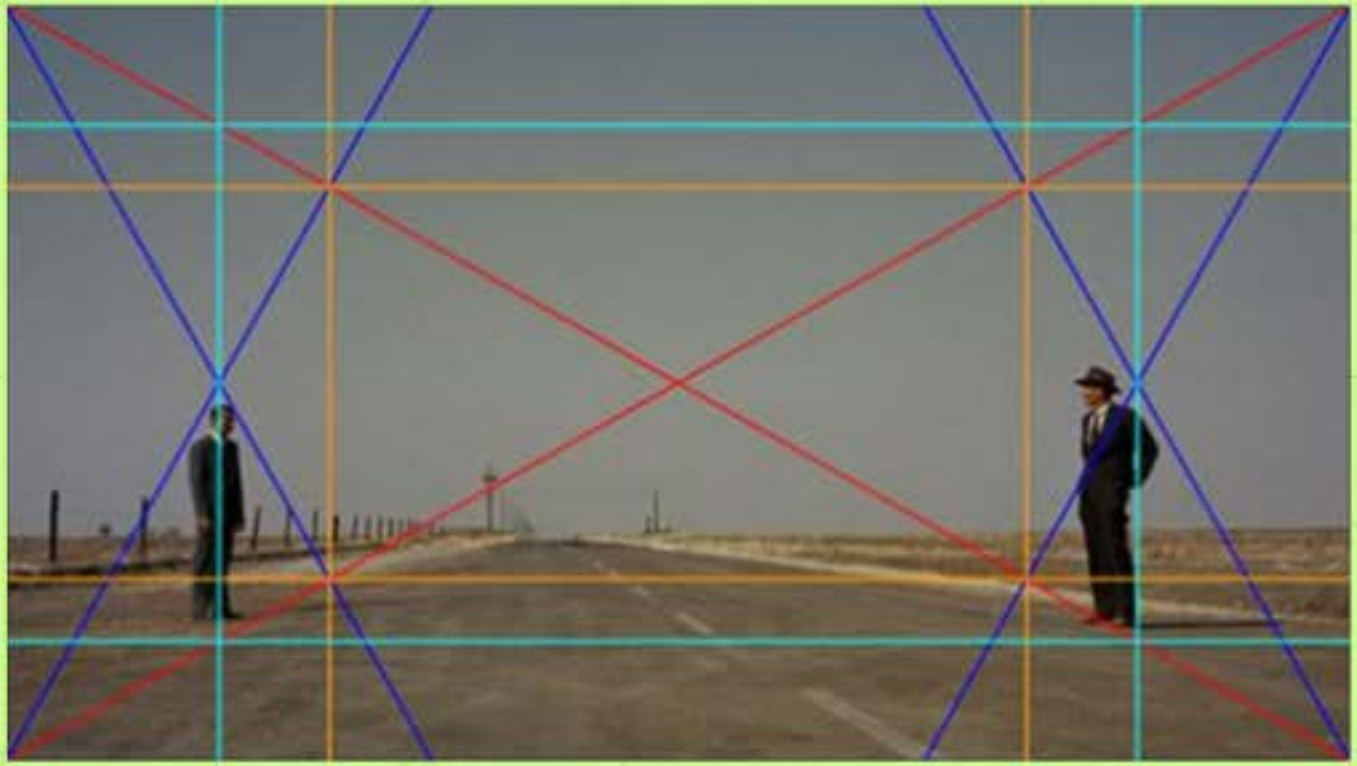


Where it finishes is pretty interesting compared to where it started.

(28,14,7)

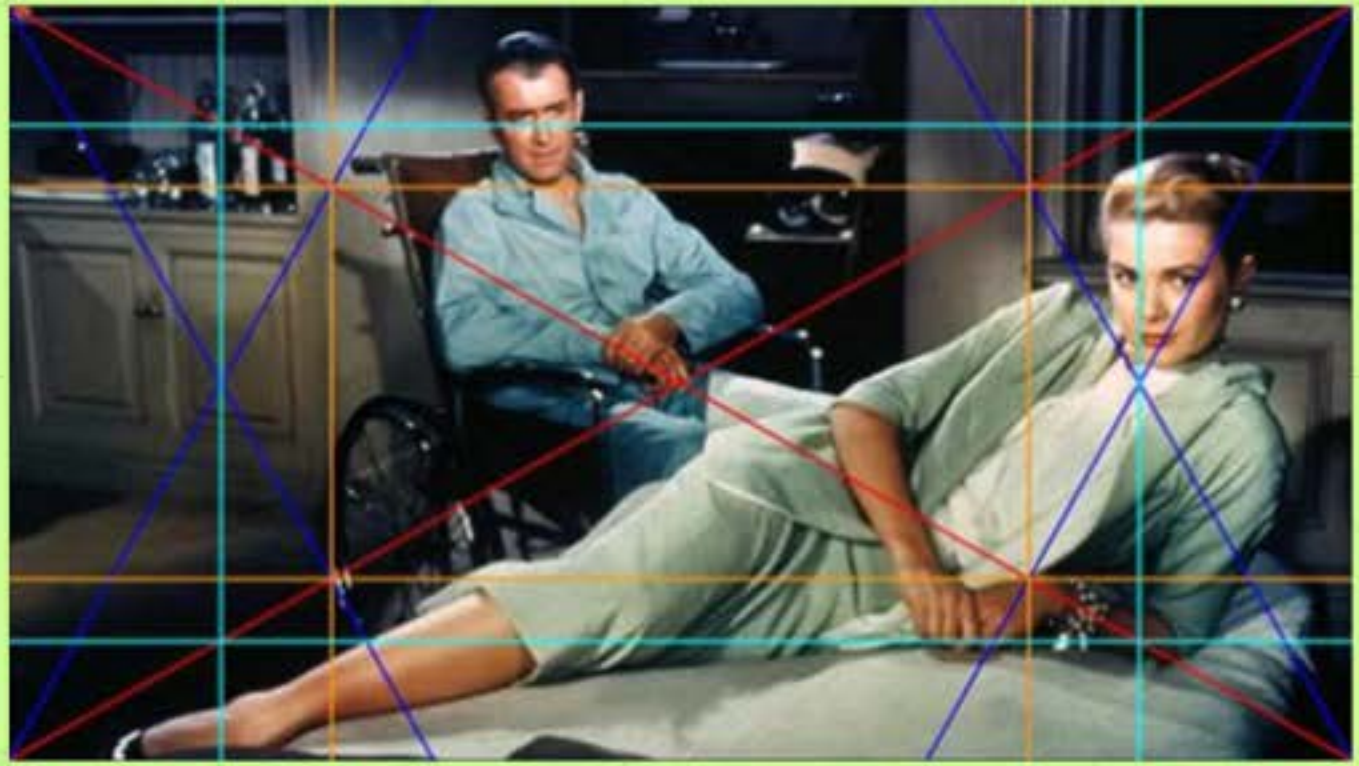
57% of the shots showed major alignment
29% were loosely aligned
14% were not aligned with the grid in any recognizable way.

Dynamic Symmetry: Alfred Hitchcock



What about Hitchcock's other movies? 'North by Northwest' shot in 1959 was filmed in the new academy ratio 1.85:1. It has many scenes that align with the grid as well.

Dynamic Symmetry: Alfred Hitchcock

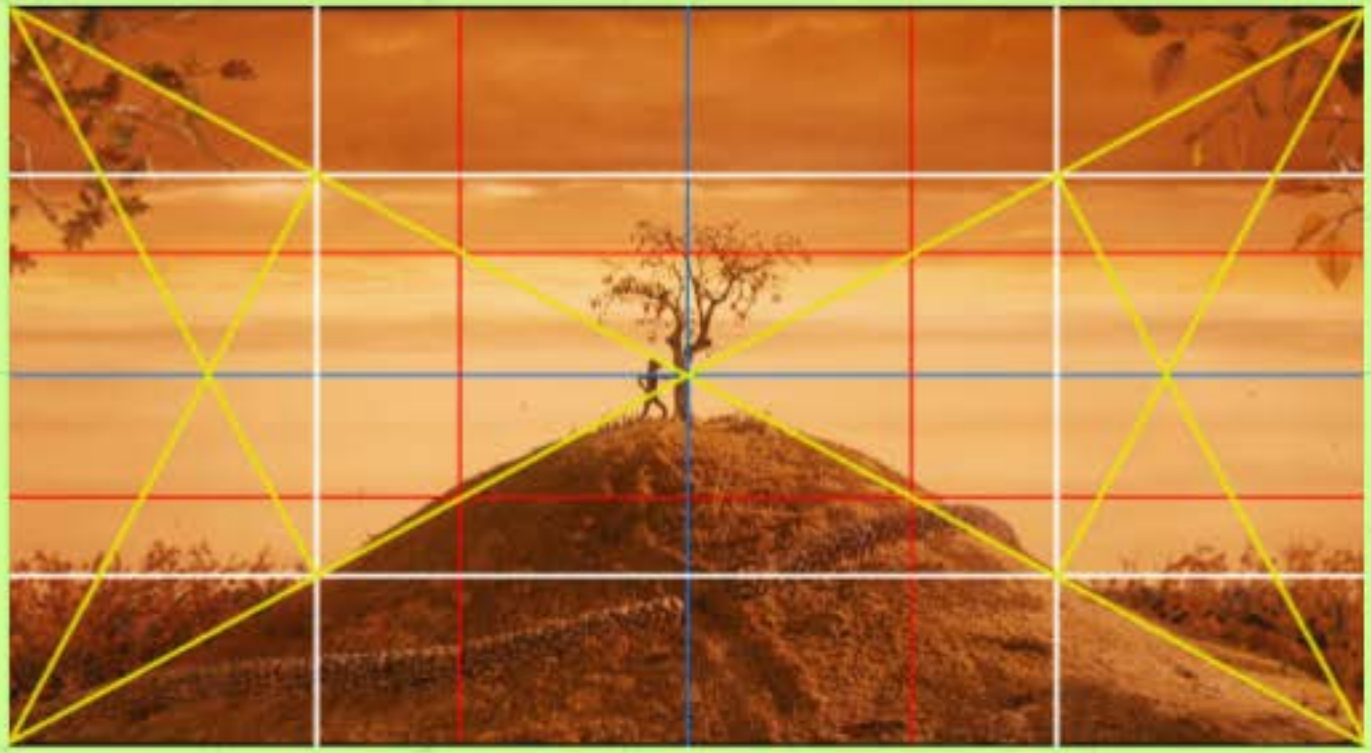


'Rear Window' shot in 1954 was also shot in the new (at the time) 1.85:1. It has many scenes that align with the grid as well. Hitchcock may use some hybrid of rule of thirds and dynamic symmetry. Notice that James Stewart aligns at the eyes but vertically he would be at a third line. Grace Kelly's eyes would also align on a horizontal third. The diagonal stacking between the two aligns perfectly with dynamic symmetry.

Dynamic Symmetry: Alfred Hitchcock

'To Catch a Thief' shot in 1955 shot in 1.85:1. More evidence of the hybrid setup. The skyline is rule of thirds, while eyelines and various scene elements and props align with dynamic symmetry. The Hybrid nature of the grid use in these new 1.85:1 formats may be Hitchcock learning to frame with a new rectangle or they may be some crossover between using more rule of thirds in the previous 1.37:1 ratio and trying to create room for the scene with the wider format.

Dynamic Symmetry: Wes Anderson



The films of Wes Anderson have a very consistent visual style and possess a startling amount of visual design and technique. Anderson is known for tracking and panning the camera from frame to frame. He shoots in a variety of aspect ratios, lenses and film formats. In spite of all of these variables, his films overlap with dynamic symmetry in almost every shot.

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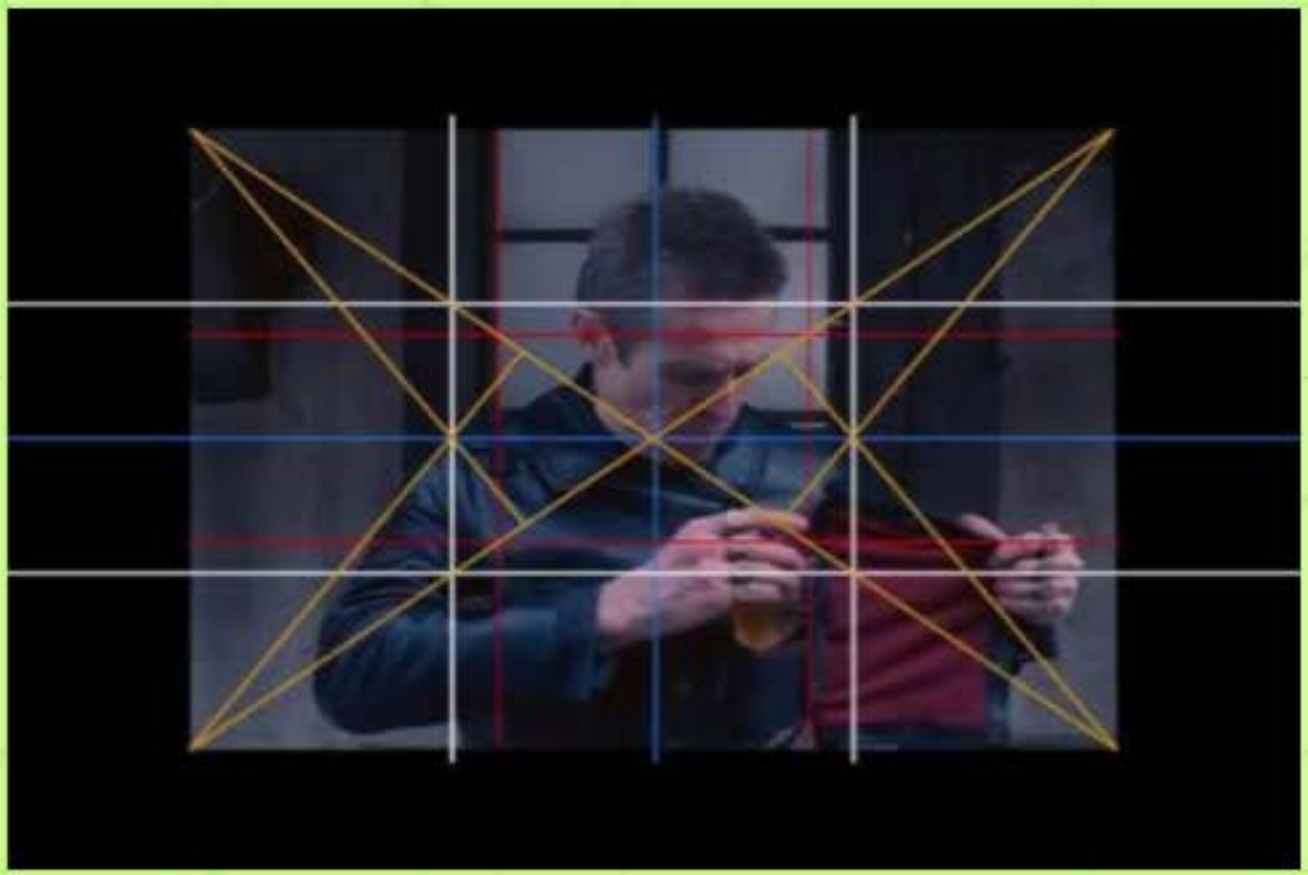
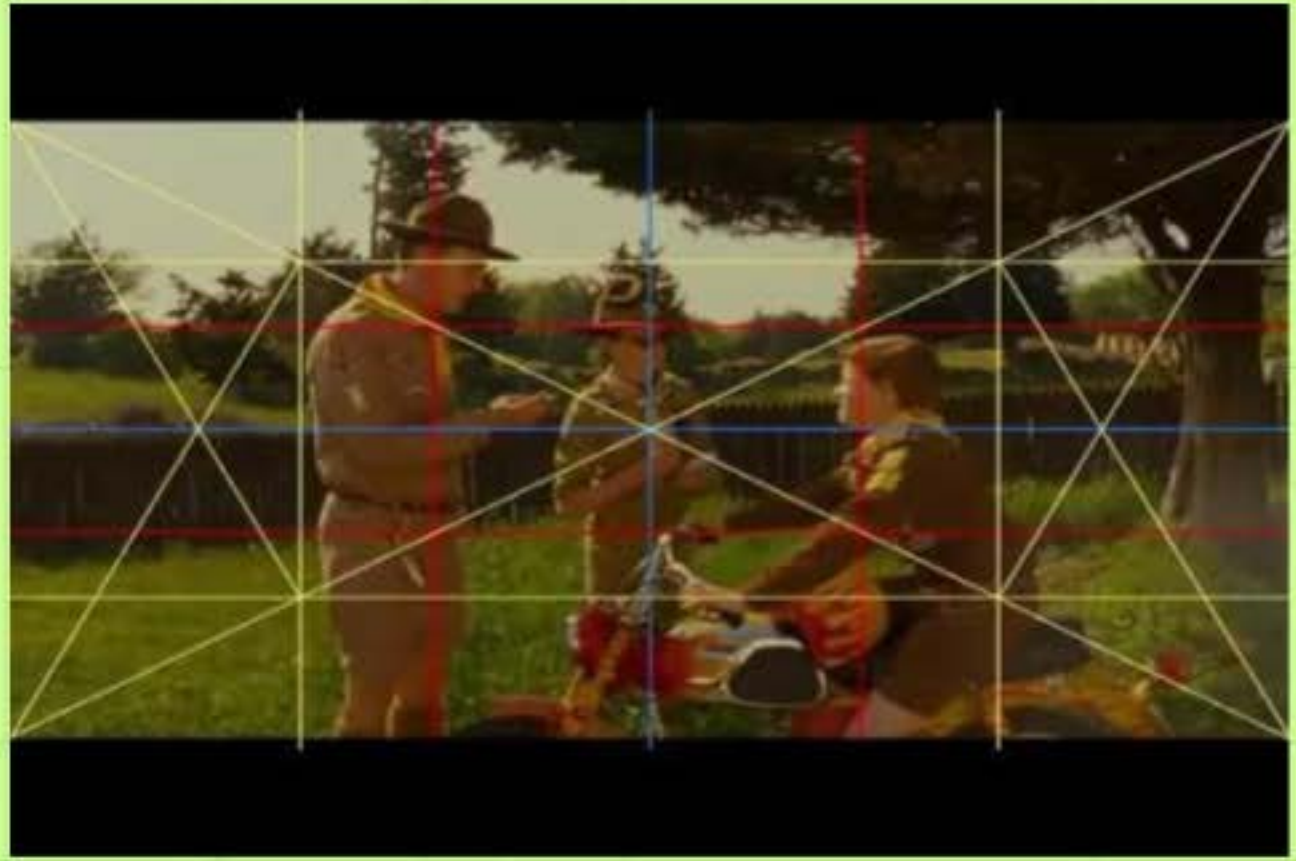


Anderson's film 'The Grand Budapest Hotel' was shot in 3 different aspect ratios representing the academy standard for the time periods shown in the film, 1.37:1 for the 1930s, 1.85:1 for the 1980s and 2010s and 2.35:1 anamorphic widescreen for the 1960s. This means that Anderson framed and designed scenes for each aspect ratio an amazing feat considering they all align perfectly with dynamic symmetry.

Dynamic Symmetry: Wes Anderson



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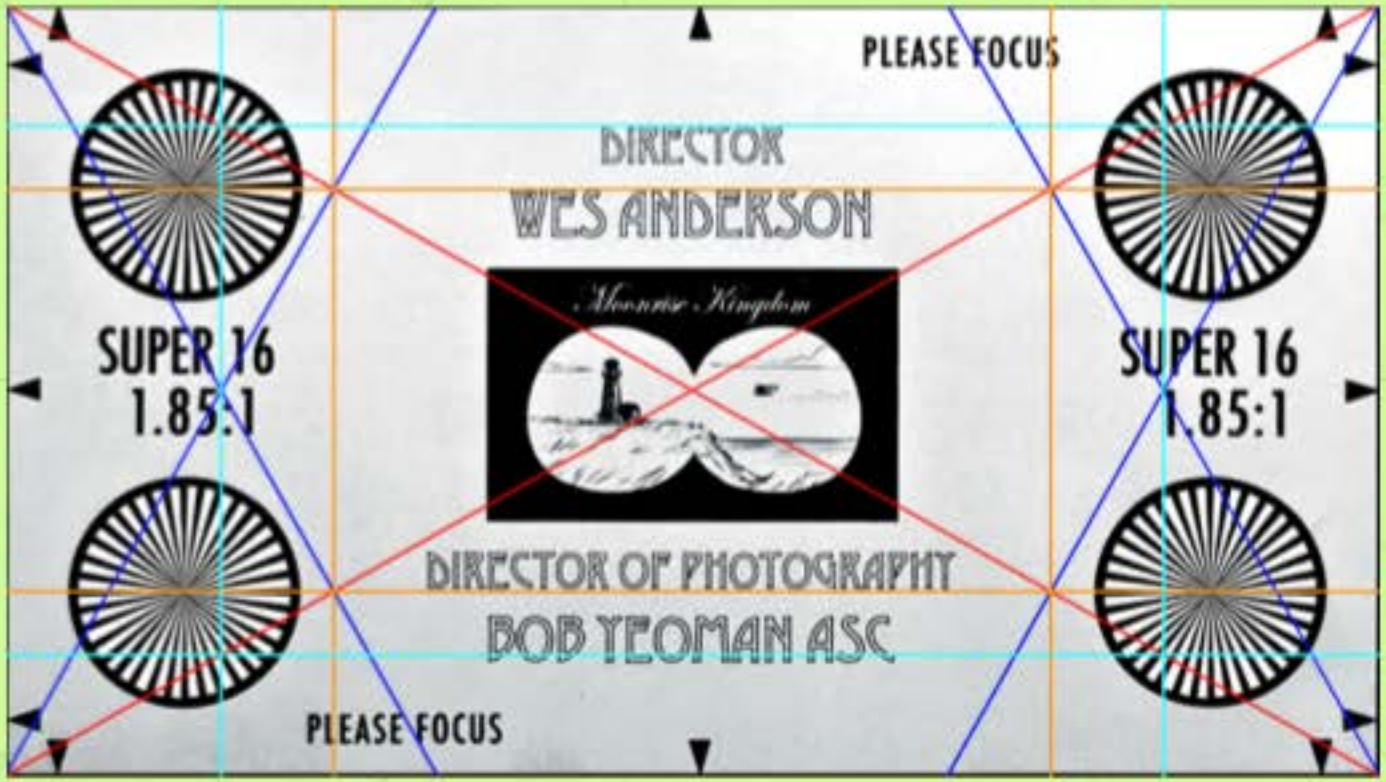
Dynamic Symmetry: the important points



One final point. To the left is a tool called a focus card. These would be used before each scene to focus the camera and check lens distortion, especially on the anamorphic lenses common in Anderson's work. The focus targets in the corners intersect perfectly with the horizontal grid lines created by the geometric means of dynamic symmetry.

Dynamic Symmetry: the important points

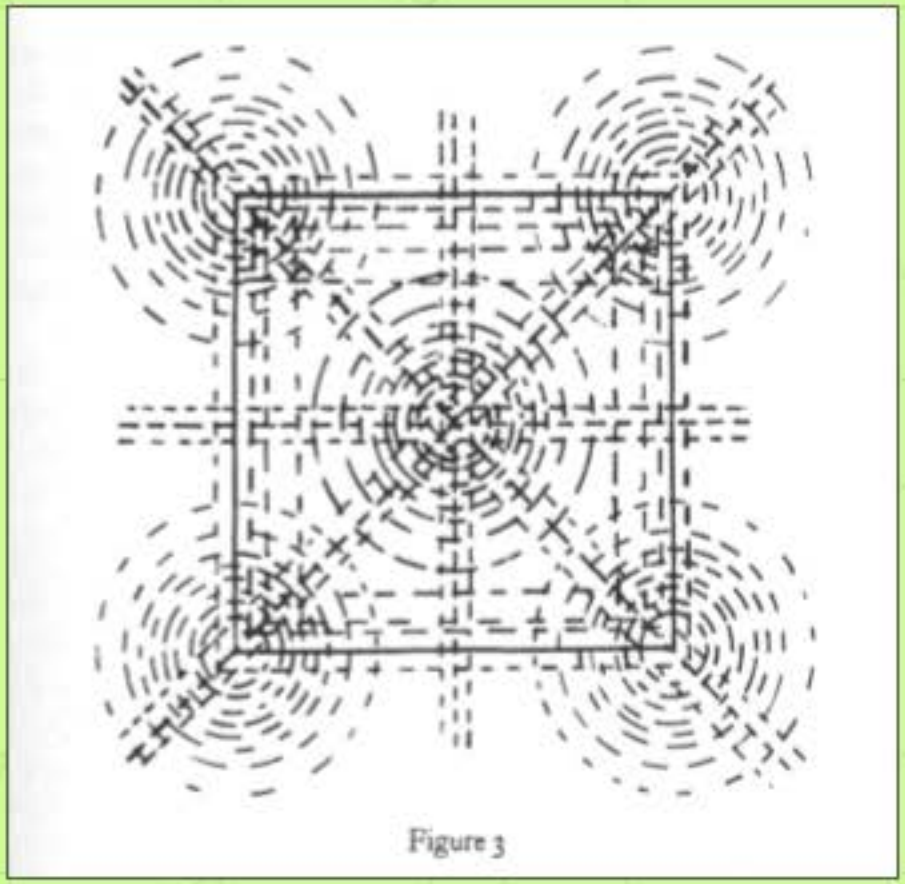


Figure 3

This image from Rudolf Arnheim's book *'Art and Visual Perception: A Psychology of the Creative Eye' illustrates an important point*. In the chapter on balance Arnheim wrote, "**A visual figure such as the square is empty and not empty at the same time. Its center is part of a complex hidden structure**…

Informal explorations show that objects located within the square are influenced not only by the boundaries and the center of the square, but also by the cross-shaped framework of the central vertical and horizontal axes and by the diagonals…

The pattern sketched in Figure 3 will be referred to as the **structural skeleton** of the square. It will be shown later that these **skeletons vary from figure to figure**."

Converting image to Composition

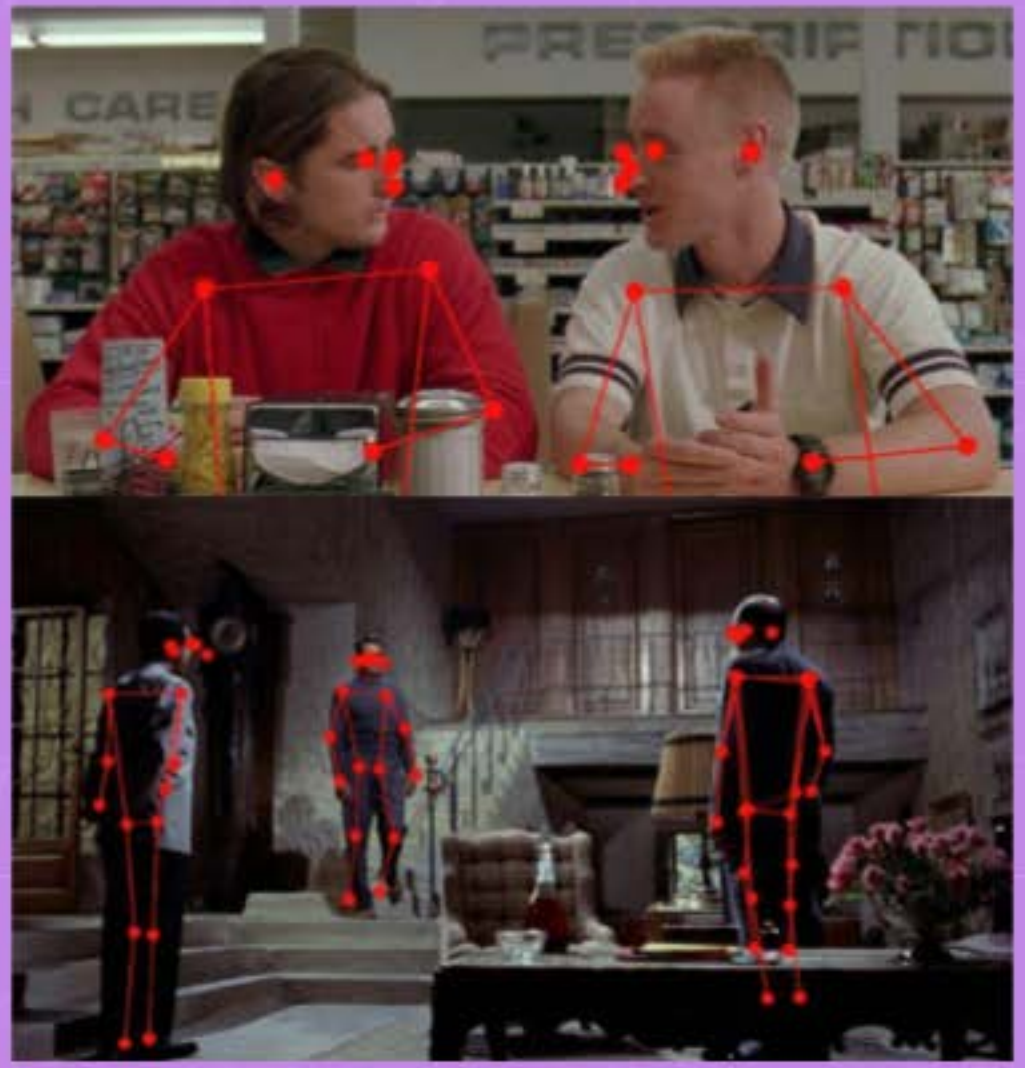
Machine learning offers several techniques for object recognition and **semantic segmentation** that help to greatly simplify the problem of understanding pixels.

Semantic segmentation identifies pixels by object classes based on a database of images which have been labeled by humans. Once the dataset is 'trained' it can be used to infer object classes for new images outside of its training set. Assuming the edges of the objects are retained, this type of image becomes a possible candidate for measuring grid alignment.

Machine Learning: semantic segmentation

The problem with semantic segmentation is that it does not show a center of alignment with a body or gaze which makes it hard to judge grid alignment with crowded scenes. Pose estimation can help with this.

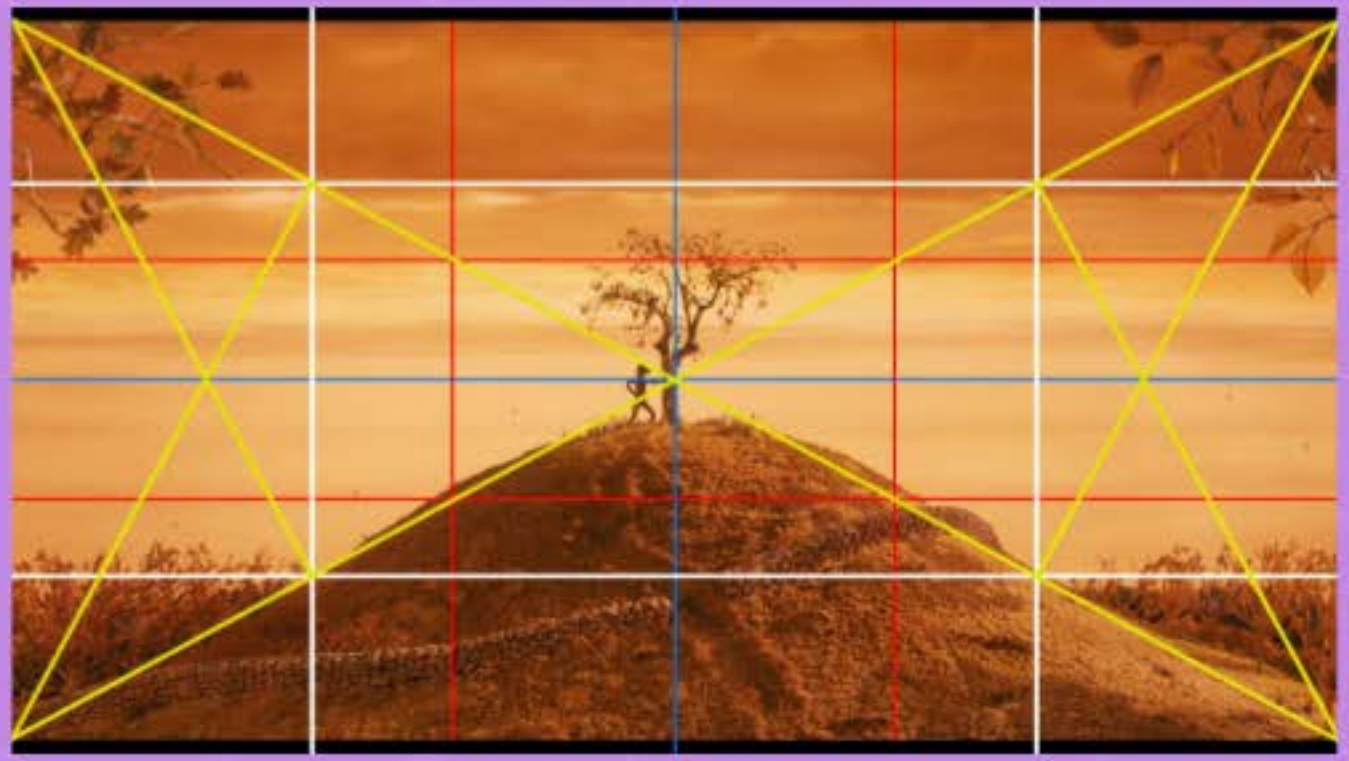
Machine Learning: Pose Estimation



Pose Estimation using machine learning offers some intriguing possibilities for determining the gaze of characters in a scene as well as their alignment along a central axis and the position of their hands and eyes.

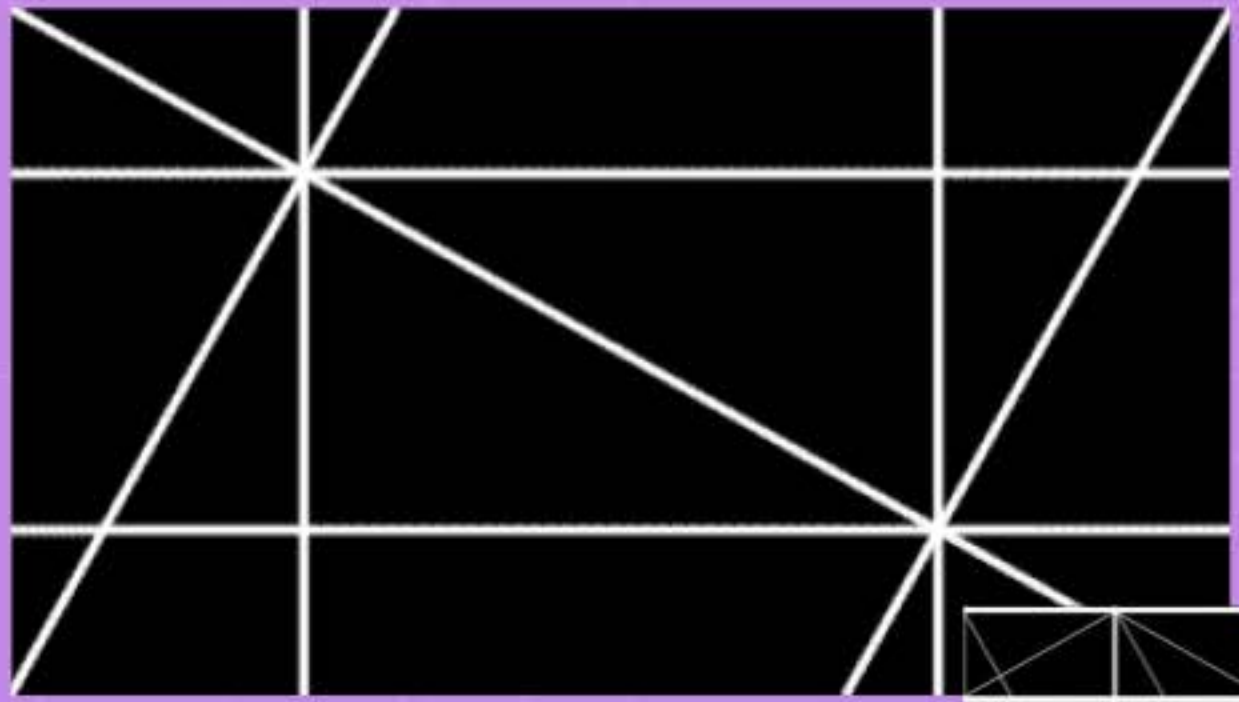
Its also remarkably resilient in detecting pose from any angle.

Machine Learning: Character recognition

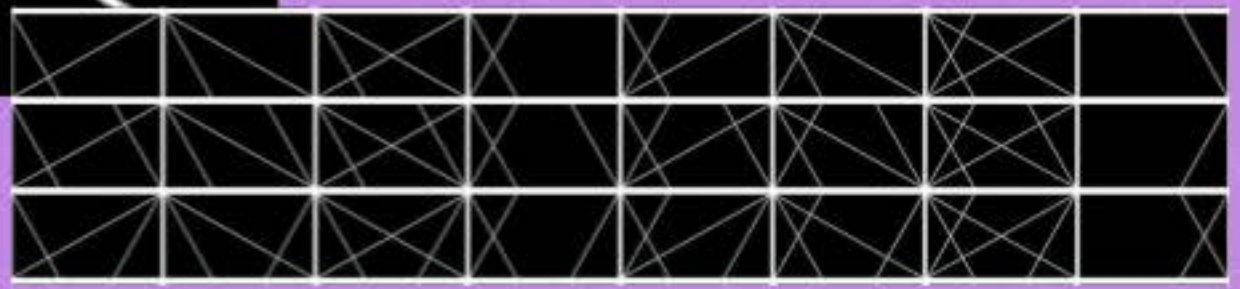


Another problem with Semantic segmentation by itself is that it doesn't recognize everything like subtle lines in the grass or the sky. These can be considered points for compositional alignment (see Wes Anderson).

Machine Learning: Character recognition



To detect edges of objects that might fall within the same class we can use ML Character based training to recognize the edges of objects in the background.

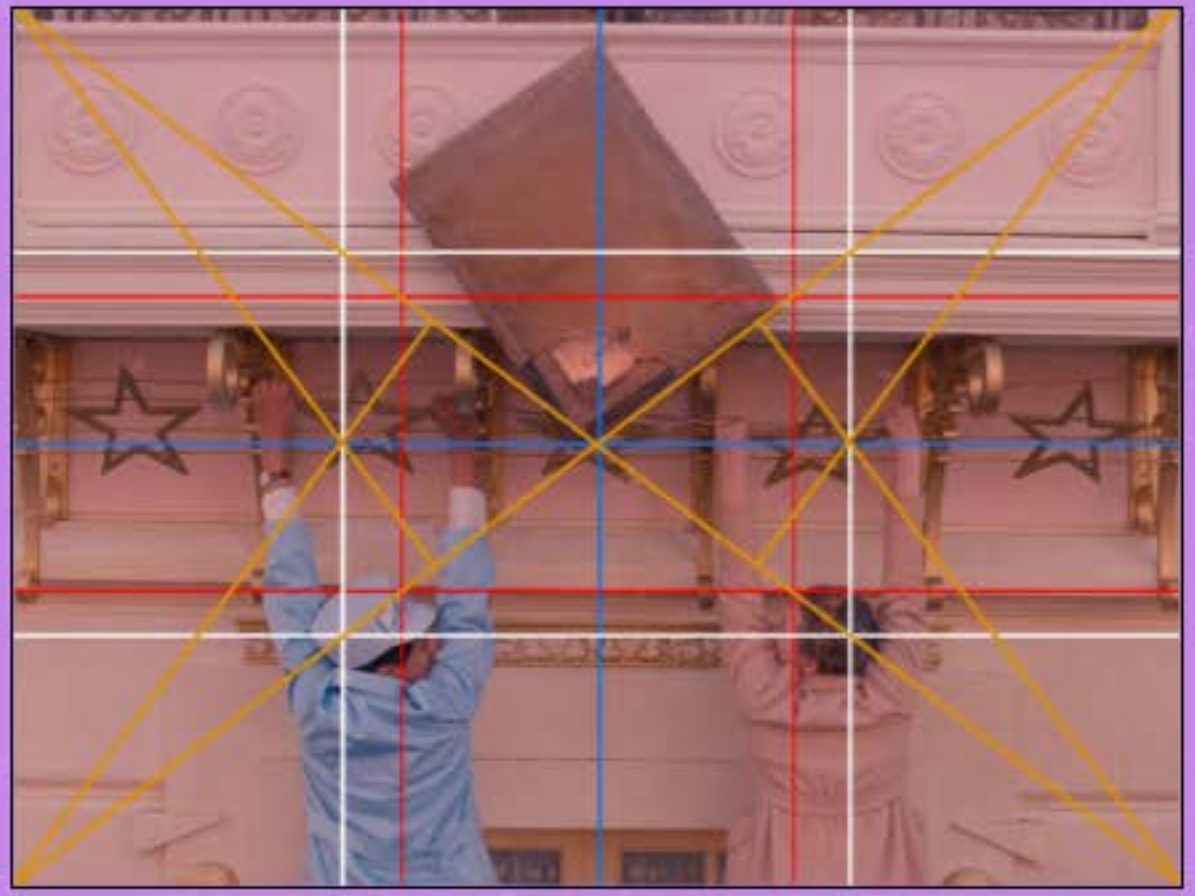


Machine Learning: Character recognition

Using Sobel edge detection on a film and training an ML model like MNIST to recognize variations of the lines in the dynamic symmetry grid can do a pretty good job of identifying variations in horizontal and diagonal alignments based on edges.

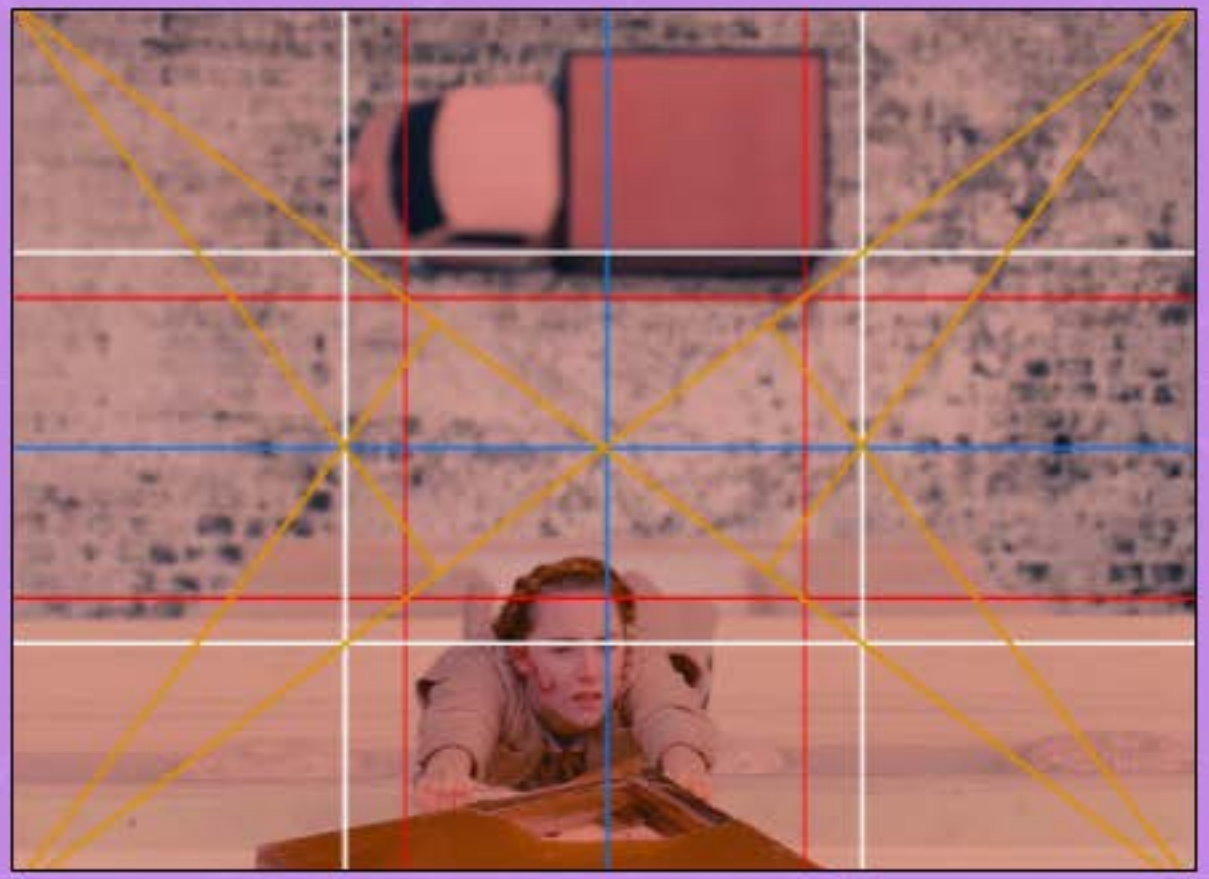
The problem is with this approach is that it has a similar drawback to semantic segmentation with recognizing the center lines and points on characters. Combining pose estimation and character recognition may solve the problem.

Analyzing composition with grids moving forward.



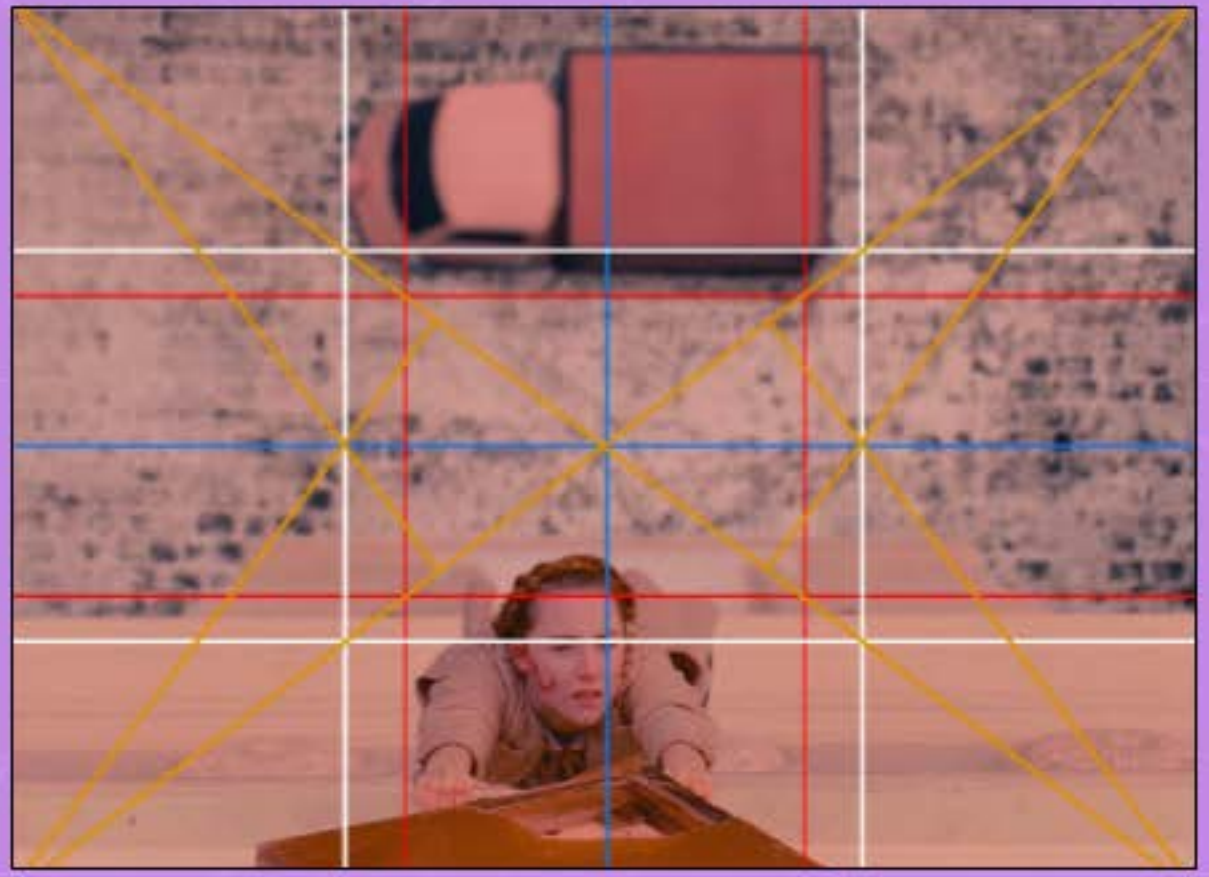
I’m working on perfecting the machine learning tools to create models designed specifically to recognize compositional formats like the dynamic symmetry grid and the rule of thirds.

Analyzing composition with grids moving forward.



With better more adept composition trained models I hope to perform surveys of film in order to study the adoption of these grids in cinema history.

Analyzing composition with grids moving forward.



The goal is to discover if this type of composition is an aesthetic ingrained in our perception (Zeising, Fechner, Hambidge, McManus, Arnheim) or whether the use of grids has reinforced its aesthetic over time through practice and social constructs.

Thank You.