We have used computational tools and techniques to analyze geometric objects, particularly straight lines and circles, in Wassily Kandinsky’s paintings. Previous research by our group at Bowdoin resulted in the creation of a program that could process and extract all the straight lines from his paintings, while concurrently generating data about the slopes and the lengths of the straight lines. We have extended this research in two ways. First, after improving the reliability of the line detection program, we have analyzed the straight-line data by producing a series of histograms displaying the statistics of line composition in Kandinsky’s paintings. Second, we have added the necessary components to process the circles in his paintings.

Wassily Kandinsky was an influential Russian artist in the early 20th century whose contribution to abstract art was instrumental in developing the field as we know it today. From 1922 to 1933 he taught at the Bauhaus, a famous German design school, by which time he had written several books on art theory and had fully developed his abstract style. Kandinsky associated shapes, lines and angles with specific colors, and declared that lines had different tensions based on their angle and location in the painting. Divided into four quadrants, the canvas became associated with different weights, which affected line tension and determined whether a line was harmonious or disharmonious. The ultimate goal of our research is to characterize the complex function that maps artistic intuition to a final composition (e.g., whether or not patterns can be identified in Kandinsky's work and whether these patterns can be used to automatically create similar art).

We have first improved our group's previous work on line detection. We have then gathered data about straight-line segments in Kandinsky's paintings. Using Microsoft Excel, we have plotted a histogram displaying the frequency of the slopes of the lines by mapping them to a range of buckets. Based off of 1500 lines from a dozen of his paintings, the most frequented slopes fall into the range of diagonal, horizontal, and vertical lines. This result falls directly in line with Kandinsky’s ideas on the various tensions that lead to compositions with structure. As he explains, “The forces of resistance can also be translated into tensions and be given graphic expression through displaced angles…The diagonal increases its inclination either to the vertical or the horizontal. It can, therefore, be looked upon as a kind of measure of tension.” Thus, it makes sense that the highest frequency values fall into these diagonal, horizontal, and vertical ranges. The histogram of line lengths also shows an interesting pattern: A great majority of the lines are very short and very few lines are very big.

We have also extracted circles from Kandinsky's paintings. For this, we have processed the images of his paintings in the following way. First, the images were blurred to minimize noise. Then, the light areas of the image were dilated and expanded to skeletonize the shapes. An edge detector isolated the outlines of all shapes on the canvas. Finally, specific geometric methods identified all the straight lines and circles. The main challenge in circle detection was that a circle may be decomposed into many small line segments. Fig. 1 shows the process.

Faculty Mentor: Mohammad T. Irfan
Funded by the Surdna Foundation Undergraduate Research Fellowship