Our eyes use two different mechanisms to direct their attention to objects at different distances. One mechanism is *focus*. Muscles in the eye adjust the focal distance of the lens such that the object we are observing has perfect focus on the retina. The other mechanism is *convergence*. If the object is far away, both eyes point almost straight ahead, while if the object is close the eyes point inward so that they are both pointing directly at the nearby object. Normally, these two mechanisms work in perfect harmony, agreeing with each other on the distance to the object. But with a little practice, most people can decouple these actions and thereby see an object in stereo, with impressive depth perception, while looking at a single image. Because only one image is needed to achieve stereo perception, such images are usually called *single-image stereograms*. There are other types of stereograms, but they are beyond the scope of this text.

To understand the essential theory behind single-image stereograms, look at Figure 1 on the next page. The vertical line in the middle of the figure represents a viewing surface, which may be something transparent such as a pane of glass, or a computer screen. An object with varying depth (distance from the eyes and viewplane) appears on the right side of the figure. Consider a point on this object being seen by both eyes. The left eye will see this point at location ***A*** on the viewplane, while the right eye will see it at location ***B***.

Suppose the viewplane is an image such as a printed graphic or a computer monitor. If we can somehow induce the eyes to focus on the viewplane while simultaneously converging behind the viewplane, and if we make points ***A*** and ***B*** identical (the same color), we can fool the brain into thinking it is looking at a point on the surface of an object behind the viewplane.

Unfortunately, things are not this simple. Look at Figure 2. Point 1 on the object requires that points ***A*** and ***B*** on the viewplane be identical. But point 2 on the object requires that points ***B*** and ***C*** on the viewplane also be identical. Point ***B*** is acting as a bridge, connecting more distant points on the viewplane. The result is that we end up with a multitude of constraints that must be imposed on the colors shown on the viewplane.

This is not a trivial undertaking, as will be seen later when the software algorithms are presented. But in most reasonable situations it can be done, and the results can be spectacular with good software in the hands of an artist. This book will document software for implementing the most important single-image stereogram algorithms, present complete source code for the key components of these algorithms, and provide basic guidance in some of the most important artistic techniques.

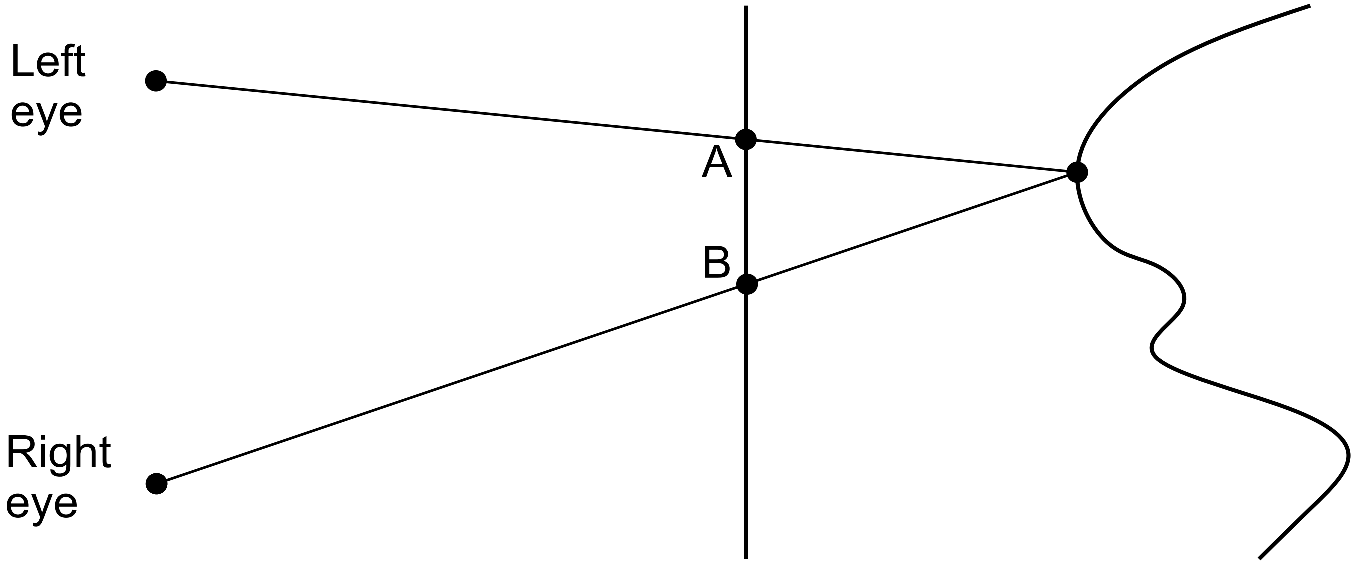

Figure 1: Simple case of single-image stereogram

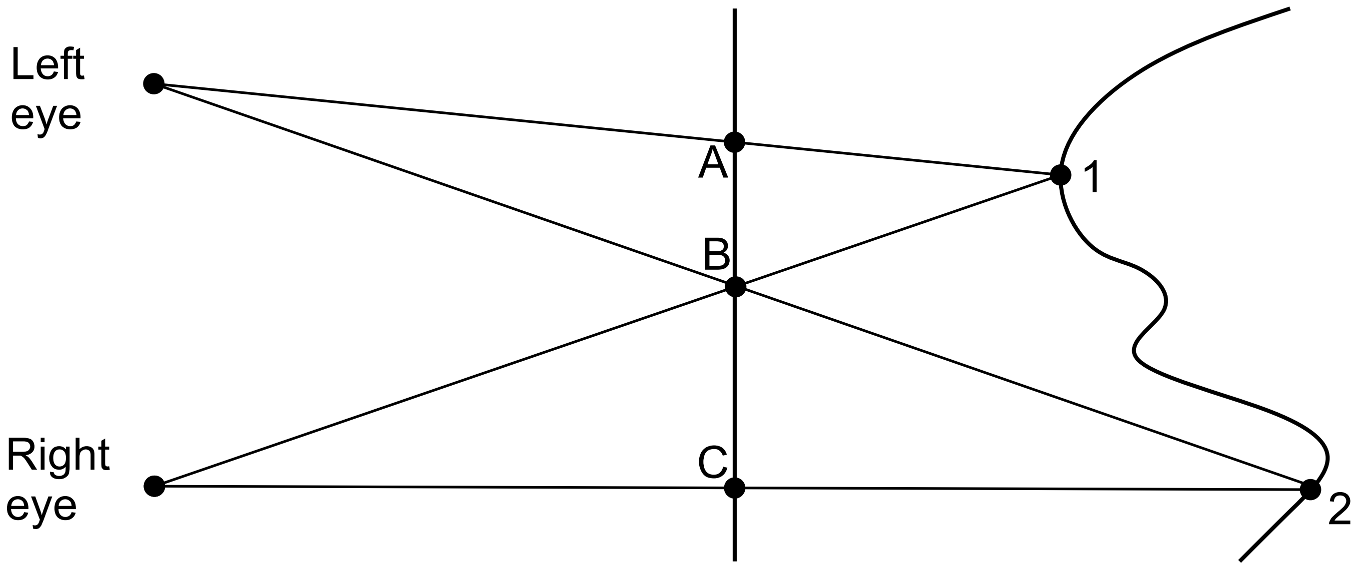

Figure 2: Chain constraints for a single-image stereogram