Astrophys Space Sci (2012) 337:79–92
DOI 10.1007/s10509-011-0801-z

ORIGINAL ARTICLE

Stereo pairs in Astrophysics

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Received: 17 February 2011 / Accepted: 13 July 2011 / Published online: 2 September 2011

Abstract Stereoscopic visualization is seldom used in Astrophysical publications and presentations compared to other scientific fields, e.g., Biochemistry, where it has been recognized as a valuable tool for decades. We put forth the view that stereo pairs can be a useful tool for the Astrophysics community in communicating a truer representation of astrophysical data. Here, we review the main theoretical aspects of stereoscopy, and present a tutorial to easily create stereo pairs using PYTHON. We then describe how stereo pairs provide a way to incorporate 3D data in 2D publications of standard journals. We illustrate the use of stereo pairs with one conceptual and two Astrophysical science examples: an integral field spectroscopy study of a supernova remnant, and numerical simulations of a relativistic AGN jet. We also use these examples to make the case that stereo pairs are not merely an ostentatious way to present data, but an enhancement in the communication of scientific results in publications because they provide the reader with a realistic view of multi-dimensional data, be it of observational or theoretical nature. In recognition of the ongoing 3D expansion in the commercial sector, we advocate an increased use of stereo pairs in Astrophysics publications and presentations as a first step towards new interactive and multi-dimensional publication methods.

Keywords Data analysis and techniques · Tutorial · Stereoscopy · Stereo pairs

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1 Introduction

Stereoscopy consists in giving a depth perception out of 2D material to the viewer, and the concept behind it is fairly simple: it requires sending distinct and carefully chosen images to each eye, without one eye noticing the images intended for the other. The notion of depth perception, or *stereopsis*, has been discussed as early as A.D. 280 by Euclid (Okoshi 1976). While there has been some experimentation using sketching techniques before 1800 (Norling 1953), the invention of photography by Niépce (Smith 1877; Perrier 1934) in the beginning of the 19th Century marked the real start of extensive experimentation with stereoscopy. Wheatstone (1838) assembled one of the earliest known stereoscopes, but Brewster is usually attributed the construction of the first practical viewing device, now referred to as the *Brewster stereoscope* (Norling 1953).

As predicted by Scripture (1899), stereoscopy encountered quite a strong success in these early times, when stereoscopes where made widely available, because the production of stereo pairs become easier as photographic techniques evolved. Darrah (1977) discusses these early ages (from 1851 to 1935) of stereoscopy in depth, and we refer the interested reader to his work for a detailed overview of the various applications of stereo pairs in those times.

Although the principle behind stereoscopy has remained the same ever since, there have been regular improvements to the methods of production and visualization. In fact, the interest in stereoscopy has been closely linked to the development of both imaging and visualization techniques (Okoshi 1976), and peaks of interest arose as new production and/or visualization tools were invented. Beside the evolution of photographic techniques, the advent of computers and their ability to produce accurate and detailed stereo pairs represents one such development which resulted in a peak of interest for stereoscopy that started in the 70'.