

# Global Illumination for Fun and Profit

Roy G. Biv, Ed Grimley, *Member, IEEE*, and Martha Stewart



Fig. 1. In the Clouds: Vancouver from Cypress Mountain. Note that the teaser may not be wider than the abstract block.

**Abstract**—Missing values are a pervasive problem in most data collection processes. Several methods can deal with missing values, and choosing one depends on the diagnosis of the missing data mechanism—the way that missingness correlates with variables. One way of diagnosing the mechanism is by comparing pairs of variables using data visualizations. However, the standard visualizations for this task use visual encodings that were not specifically designed for it, thus making the user actively pursue cues to support reasoning instead of explicitly presenting them. Thus, this paper proposes a visual-interactive idiom for diagnosing missing data mechanisms. The approach consists of design choices for visual encodings and interactions that support the steps of diagnosis, and also a data derivation algorithm that quantifies two metrics to assist reasoning: randomness similarity—how much the missing data differs from a perfect uniform sample—and randomness plausibility—how much the difference between those distributions resembles a random shape. This paper presents the data derivation algorithm and the design choices for the visual encodings, showing how it supports the whole diagnosis task. We use synthetic data to validate the ability of the idiom in depicting the missing data mechanisms, and then apply the idiom to real data to demonstrate how it can assist in practical analysis scenarios.

**Index Terms**—Radiosity, global illumination, constant time

## 1 INTRODUCTION

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• Roy G. Biv is with Starbucks Research. E-mail: roy.g.biv@aol.com.  
• Ed Grimley is with Grimley Widgets, Inc.. E-mail: ed.grimley@aol.com.  
• Martha Stewart is with Martha Stewart Enterprises at Microsoft Research. E-mail: martha.stewart@marthastewart.com.

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2016	30		37	33	15	23	10	148	115
2015	33	9	38	33	14	17	15	159	127
2014	34		45	33	21	20		153	133
2013	31		38	32		20		121	101
2012	42		44	30		23		139	116
2011	49		44	26		20		139	119
2010	48		35	26				109	109
2009	54		37	26				117	117
2008	50		28	21				99	99
2007	56		27	24				107	107
2006	63		24	26				113	113
2005	88		31					119	119
2004	70		27					97	97
2003	74		29					103	103
2002	78		23					101	101
2001	74		22					96	96
2000	73		20					93	93
1999	69		19					88	88
1998	72		18					90	90
1997	72		16					88	88
1996	65		12					77	77
1995	56		18					74	74
1994	53							53	53
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Fig. 2. A visualization of the 1990–2015 data from Table 1. The image is from [?] and is in the public domain.

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<sup>1</sup>The algorithm behind Marching Cubes [?] had already been described by Wyvill et al. [?] a year earlier.

<sup>2</sup>Footnotes appear at the bottom of the column.

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## 6 CONCLUSION

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## ACKNOWLEDGMENTS

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