

# A Study on a User-Controlled Radial Tour for Variable Importance in High-Dimensional Data

Category: Research

Paper Type: application/design study

**Abstract**—Principal component analysis is a long-standing go-to method for exploring multivariate data. The principal components are linear combinations of the original variables, ordered by descending variance. The first few components typically provide a good visual summary of the data. *Tours* also make linear projections of the original variables but offer many different views, like examining the data from different directions. The grand tour shows a smooth sequence of projections as an animation following interpolations between random target bases. The manual radial tour rotates the selected variable's contribution into and out of a projection. This allows the importance of the variable to structure in the projection to be assessed. This work describes a mixed-design user study evaluating the radial tour's efficacy compared with principal component analysis and the grand tour. A supervised classification task is assigned to participants who evaluate variable attribution of the separation between two classes. Their accuracy in assigning the variable importance is measured across various factors. Data were collected from 108 crowdsourced participants, who performed two trials with each visual for 648 trials in total. Mixed model regression finds strong evidence that the radial tour results in a large increase in accuracy over the alternatives. Participants also reported a preference for the radial tour in comparison to the other two methods.

**Index Terms**—Multivariate data visualization, variable importance, radial tour

## 1 INTRODUCTION

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## 4 EXAMPLE SECTION

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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.

Table 1. VIS/VisWeek accepted/presented papers: 1990–2016.

| year | Vis/SciVis | SciVis conf | InfoVis | VAST | VAST conf | TVCG @ VIS | CG&A @ VIS | VIS/VisWeek incl. TVCG/CG&A | VIS/VisWeek w/o TVCG/CG&A |
|------|------------|-------------|---------|------|-----------|------------|------------|-----------------------------|---------------------------|
| 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                        |
| 1993 | 55         |             |         |      |           |            |            | 55                          | 55                        |
| 1992 | 53         |             |         |      |           |            |            | 53                          | 53                        |
| 1991 | 50         |             |         |      |           |            |            | 50                          | 50                        |
| 1990 | 53         |             |         |      |           |            |            | 53                          | 53                        |
| sum  | 1545       | 9           | 632     | 310  | 50        | 123        | 25         | 2694                        | 2546                      |

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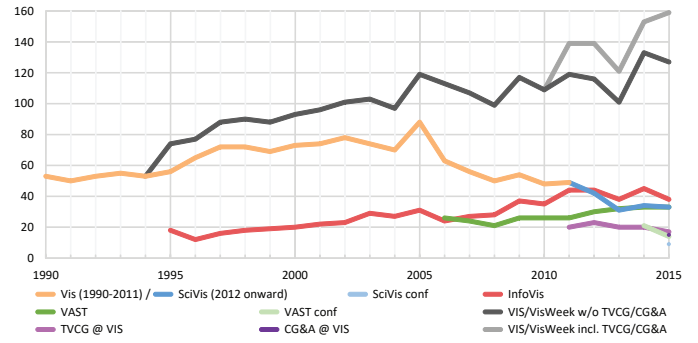


Fig. 1. A visualization of the 1990–2015 data from Table 1. The image is from [?] and is in the public domain.

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## 6 CONCLUSION

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## REFERENCES