Dual Screen Presentations with the LaTeX Beamer Class under X

Klaus Dohmen

Email	dohmen@hs-mittweida.de
Website	http://www.hs-mittweida.de/dohmen
address	Hochschule Mittweida, University of Applied Sciences, Technikumplatz 17, 09648 Mittweida, Germany

Abstract   We show how the X Resize, Rotate and Reflect Extension of the X Window System can be used to display a LaTeX beamer presentation on one or two beamers while simultaneously displaying the output of both beamers on the lecturer's display. If only one beamer is used, the lecturer's display might show both the output of the beamer and hidden notes.

Contents

1   Introduction

In recent years, the LaTeX beamer class has become a very popular tool for creating PDF presentations [1]. An interesting feature of the beamer class is its ability to put additional material like notes, translations or previous slides on a secondary screen [1, pp. 187, 197–198]. This is accomplished by employing the *pgfpages*

package to create pages which are twice as wide as usual, but which have the same usual height.

The intention is that the left-hand side of each "double" page is directed to the first video output (the beamer) and the right-hand side to the second (the internal screen or a secondary beamer). To achieve this, the windowing system must be configured to use a virtual display, which is large enough to accomodate both screens. As an application, a lecturer might present slides on a beamer while reading notes not intended for the audience on his laptop (see Figure 1 for an example). Alternatively, he might present different slides on two beamers, e.g., the current and the previous slide, or slides in different languages.

Even if cloning of screens is supported by the windowing system, the lecturer is faced with the problem that he cannot see both the slides and the notes, respectively the slides on each of the two beamers, *simultaneously* in one place.

In this note, we present a solution to this problem. Our method relies on recent features of X.Org — the free open-source implementation of the X Window System. It works without configuring a virtual display.

The method was tested on a Lenovo W500 with Kubuntu 9.10 (X.Org version 7.4, XRandR version 1.3, Adobe Reader 9.2). The W500 has an ATI Mobility Radeon HD 3650 graphics card and a 1920×1200 TFT display.
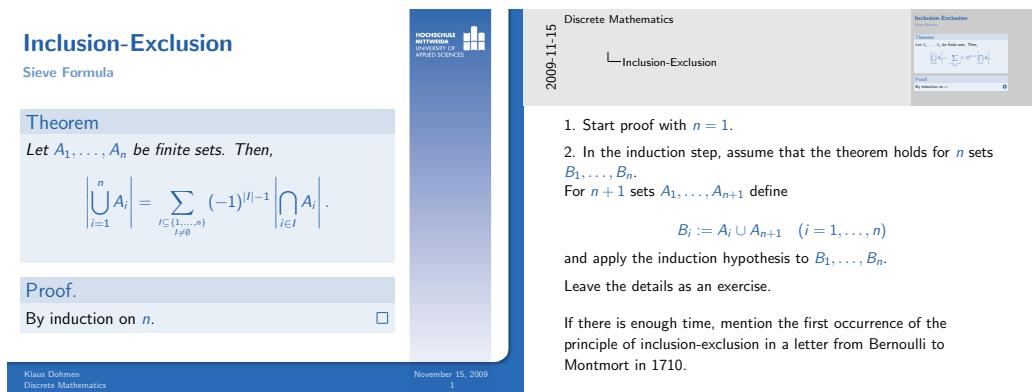

Figure 1: Only the left part of this double page is intended for the audience.

2 The X Resize, Rotate and Reflect Extension

Our method makes use of the X Resize, Rotate and Reflect Extension, which is abbreviated to XRandR [2]. The basic usage of XRandR is

`xrandr --output` *screen* `--mode` *width* x *height* `--scale` s_xxs_y `--pos` p_xxp_y

For a default presentation on a beamer with 1024×768 pixels, one throws the command

`xrandr --output LVDS1 --mode 1024x768 --output VGA1 --mode 1024x768`

without scaling and positioning parameters.[1][2] In our case, VGA1 refers to the beamer, and LVDS1 to our laptop's internal display. For other video cards, it might be necessary to replace VGA1 by VGA or VGA-0, likewise for LVDS1.

To turn off the beamer, and to reset the laptop's internal display to its default maximum resolution, we use the command

`xrandr --output LVDS1 --auto --output VGA1 --off`

For more options and details on the usage of XRandR, the reader is referred to its manual page.

3 Standard presentations

The method of the preceding section requires that the internal display is capable of the beamer's resolution. While most laptops and desktop computers satisfy this constraint, there are good reasons to consider a more flexible approach. First of all, the user might decline changing the configuration of his primary display. In fact, changing the configuration is not necessary as we will see below. Second, small netbooks become more and more popular, which offer an even lower resolution than beamers. Another challenge arises from the fact that modern laptops and netbooks have an aspect ratio which is greater than $4:3$, which is the de-facto standard for beamers.

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1. For an automatic configuration, first connect the beamer to the graphics port and then start X.
2. If you try out the commands in Section 3 and 4 and return to the present one, be sure to add `--scale 1x1 --pos 0x0 --fb 1024x768` to reset the scaling and positioning parameters.

A configuration leaving the resolution of the user's display unattached is obtained by invoking XRandR with appropriate scaling and positioning parameters. For the computation of these parameters, we introduce the following variables (see also Figure):

$$
\begin{aligned}
b_x, b_y &= \text{width and height of the beamer's screen, } b_x : b_y = 4 : 3; \\
f_x, f_y &= \text{width and height of each frame in the user's display, } f_x : f_y = 4 : 3; \\
l_x, l_y &= \text{width and height of the user's display;} \\
p_x, p_y &= \text{coordinates of the (0,0) position on the beamer in the user's display;}^4 \\
s &= \text{horizontal and vertical scaling factor for the beamer.}
\end{aligned}
$$

Throughout, width and height are given in pixels. As a requirement, $l_x : l_y \geq 4 : 3$; otherwise, the method will not work. By this requirement and since the ratio of each LaTeX beamer frame is $4 : 3$, it follows that $f_y = l_y$ and hence,

$$
f_x = \frac{4}{3}f_y = \frac{4}{3}l_y; \quad s = \frac{f_x}{b_x} = \frac{4l_y}{3b_x}.
$$

Evidently,

$$
p_x = \frac{l_x - f_x}{2} = \frac{1}{2}l_x - \frac{2}{3}l_y; \quad p_y = 0.
$$

The initial requirement guarantees that $p_x \geq 0$.

As an example, consider a laptop with internal screen resolution $l_x = 1920$, $l_y = 1200$, which is connected to a beamer with resolution $b_x = 1024$, $b_y = 768$. We calculate $s = 1.5625$ and $p_x = 160$, so we invoke[5]

```
xrandr --output VGA1 --mode 1024x768 --scale 1.5625x1.5625 --pos 160x0
```

in order to display the LaTeX beamer frame both on the laptop and the beamer.

---

4. Note that, by convention, the (0,0) position of any screen is on its top left corner.
5. If you tried out the commands in Section 2, be sure to add "`--output LVDS1 --mode` l_xxl_y" to the invocation of `xrandr` in order to reset the resolution of the laptop's internal display.

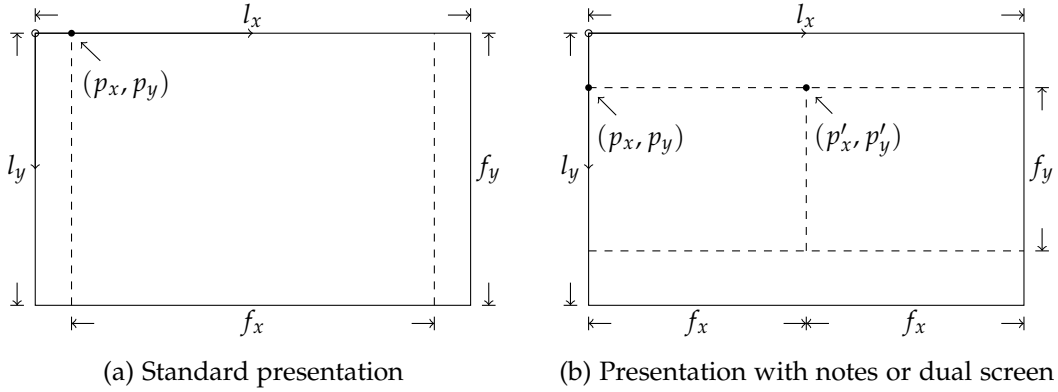(a) Standard presentation   (b) Presentation with notes or dual screen

Figure 2: Lengths and positions as defined on the preceding page.

4 Presentations with notes and dual screen presentations

In a dual screen presentation with the LATEX beamer class, pages are twice as wide as usual, while having the usual height. The left-hand side of each double page is to be shown on a beamer, while the right-hand side (containing notes or other second mode material) is to be shown on the user's display or on a secondary beamer.

For a lecturer it is important to have all necessary information simultaneously in one place. So our intention is that *both* the left-hand side and the right-hand side of each double page is shown on the lecturer's display. Moreover, only the left-hand side of each double page is presented on the beamer, while the right-hand side remains hidden to the audience or is shown on a secondary beamer.

As single beamer frames have an aspect ratio of $4 : 3$, the ratio of a double page is $8 : 3$, so $l_x : l_y \leq 8 : 3$ is a requirement.

We use the same variables as in Section 3, with primed versions in case of a secondary beamer, see Figure 2b for details. Evidently, $2f_x = l_x$ and hence,

$$ s = \frac{f_x}{b_x} = \frac{l_x}{2b_x} \, ; \quad s' = \frac{f_x}{b'_x} = \frac{l_x}{2b'_x} \, . $$

Evidently, $p_x = 0$, $p'_x = l_x/2$, and

$$p_y = p'_y = \frac{l_y - f_y}{2} = \frac{1}{2}l_y - \frac{3}{8}f_x = \frac{1}{2}l_y - \frac{3}{16}l_x .$$

The initial requirement guarantees that both p_y and p'_y are non-negative.

As an example, let us again consider a laptop with internal resolution $l_x = 1920$, $l_y = 1200$, which is connected to a beamer with resolution $b_x = 1024$, $b_y = 768$. We calculate $s = 0.9375$ and $p_y = 240$, so we invoke

```
xrandr --output VGA1 --mode 1024x768 --scale 0.9375x0.9375 --pos 0x240
```

in order to display the left-hand side of each double page on the beamer.

If, in addition, the right-hand side is to be shown on a secondary beamer connected to, say VGA2 (e.g., by using an external graphics adapter), then since the x-coordinate of the left-upper point on the right-hand side is given by $p'_x = l_x/2 = 960$, the invocation becomes

```
xrandr --output VGA1 --mode 1024x768 --scale 0.9375x0.9375 --pos 0x240
       --output VGA2 --mode 1024x768 --scale 0.9375x0.9375 --pos 960x240
```

Eventually, the width, height and scaling factor have to be adapted for the secondary beamer. In some cases it might be necessary to try out positioning parameters close to the calculated values in order to improve the result.

5   Conclusion

We presented a method for showing LaTeX beamer frames on one or two beamers, where the output of both beamers, respectively the output of one beamer together with additional notes, are simultaneously visible on the lecturer's display. This is achieved by making use of XRandR—the X Resize, Rotate and Reflect Extension of the X Window System.

Dual screen presentations with two beamers, of course, require a machine having two output devices. Alternatively, one might consider an approach where the frames for the secondary beamer are sent via network connection to another machine to which the secondary beamer is connected to. In this case, the scaling and positioning parameters calculated in Section 4 can be used as well.

References

[1] T. Tantau, *User's Guide to the Beamer Class*, Version 3.01. `CTAN:macros/latex/contrib/beamer/doc/beameruserguide.pdf`

[2] X.Org Foundation, *RandR Documentation*, `http://www.x.org/wiki/Projects/XRandR`.