

KETCindy

– linkage between dynamic geometry and T_EX graphics –

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Abstract

T_EX has become most major tool to edit teaching materials in collegiate mathematics education because it provides high quality output of mathematical expressions and automates most aspects of publishing features. However, it is not so easy for teachers to generate high quality “graphics” in final output of T_EX. We have developed K_ETpic which is a macro package of Computer Algebra System (CAS) to convert the graphical output of CAS into T_EX readable code (<http://ketpic.com>). Though it has turned out that using precise graphics generated with K_ETpic is extremely effective for students to connect their intuitive observation and deductive reasoning [1, 2], its linkage to the interactive presentation of graphics has not been sufficient. Therefore, we recently developed **KETCindy**. It is a plugin of Cinderella, one of the most popular Dynamic Geometry Software (DGS), to generate graphical data for interactive presentation on Cinderella screen and export the corresponding K_ETpic code simultaneously.

For example, Figure 1 on Cinderella screen was used to explain the parametric representation of a parabola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$:

$$x = a \cosh t, \quad y = b \sinh t$$

and the colored region corresponds to the range $\alpha \leq t \leq \alpha + \frac{1}{2}$ of parameter t . As seen in the figure, the slider is also generated so that students can change the value of α interactively.

On the one hand, some students could conjecture that the area of this colored region is independent of the value α by moving the region via slider. In fact, it is a global description of Kepler’s second law.

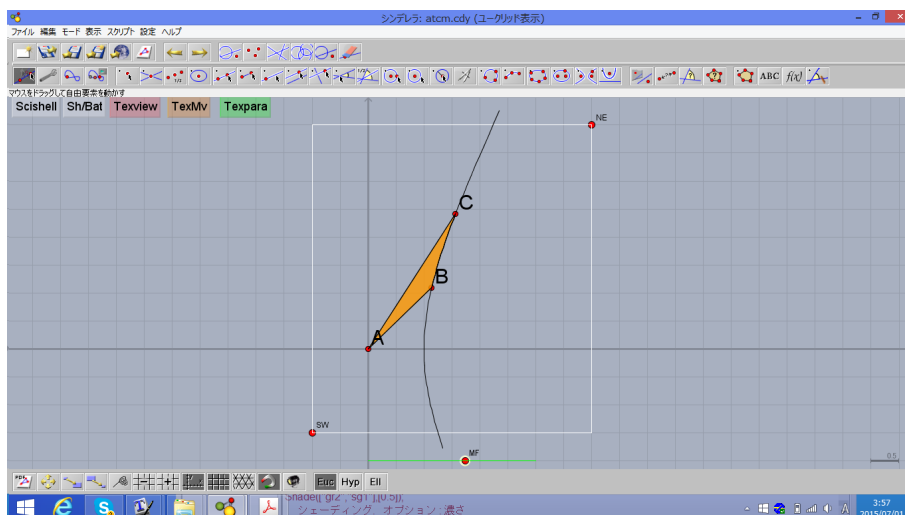


Figure 1

On the other hand, they could verify the above mentioned conjecture by observing Figure 2 generated on $\text{T}_{\text{E}}\text{X}$ printed output via KETCindy. In this reasoning process, students added the expressions for the coordinates of A, $a \cosh \alpha$ and that of B, $a \cosh \left(\alpha + \frac{1}{2} \right)$. They also calculated the area of the region S as the definite integral

$$\int_{\alpha}^{\alpha + \frac{1}{2}} b \sinh t \cdot (a \cosh t)' dt$$

on the same printed material.

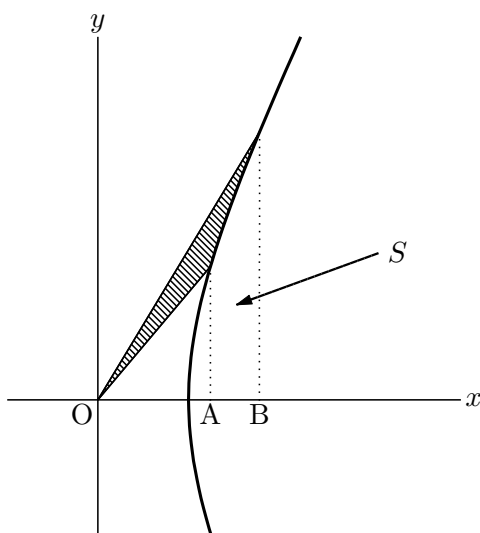


Figure 2

We can also generate some “animation” on PDF document via KETCindy as in Figure 3 (Please open this abstract via Acrobat Reader and click the figure part). The command lines (on Cindyscript) to generate it is quite simple as shown in Figure 4

Figure 3

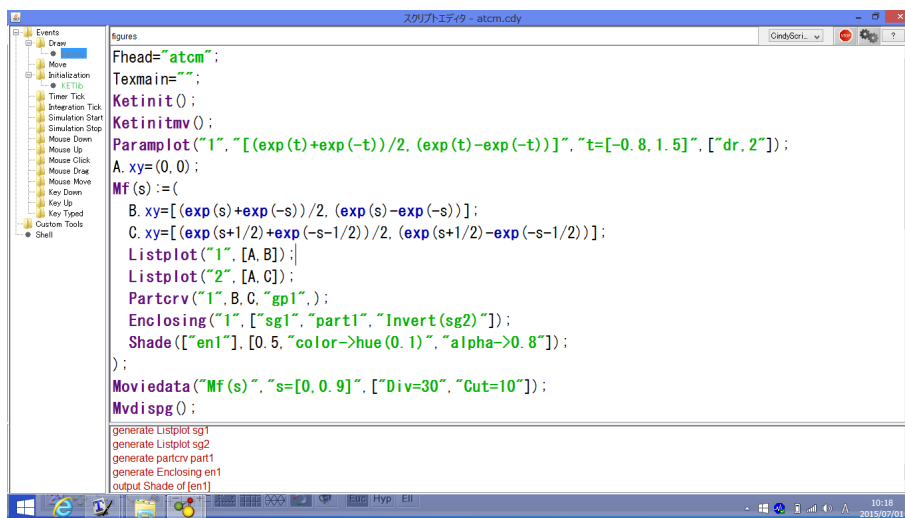


Figure 4

The capability of KETCindy to generate such PDF output should serve as a powerful tool to edit various teaching materials like e-books.

In the workshop, we will show the usage of KETCindy package and its practical use in education.

References

- [1] Kaneko M. and Takato S., "The effective use of LaTeX drawing in linear algebra", *The Electronic Journal of Mathematics and Technology*, **5-2**, 129-148, 2011
- [2] Kitahara K., Kaneko M. and Takahashi T., "On some attempts to verify the effect of using high-quality graphics in mathematics education", *Lecture Notes in Computer Science*, **8592**, 578-585, 2014