An Attempt to Create Teaching Materials for the Brachistochrone Curve Using Algebrite and KeTLTS

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Abstract

KeTCindy/KeTCindyJS is a library for LaTeX and HTML that we have developed. It is based on the dynamical geometry system Cinderella. Using it, we have also created a learning data transfer system named KeTLTS. The brachistochrone curve is an interesting topic in mathematics and physics education, so we produced the HTML with KeTLTS.

1 Introduction

The brachistochrone curve is an interesting topic in mathematics and physics education, and it would be more effective if there were interactive teaching materials. So far, we have developed KeTCindy([1]), KeTCindyJS([2]), and KeTLTS([3]). Here, 'KET' is an acronym for Kisarazu(our city), Education, and Takato with his friends. Using these tools, we decided to create HTML teaching materials for the brachystochrone curve. In this HTML, a cubic Bézier curve is used, and the control points can be moved to perform an animation to find the curve with the shortest time.

2 Outline of the HTML

Additionally, the following scripts are used in Maxima to calculate the motion of points on the curve in KeTCindy, but Maxima cannot be executed from the HTML. So only the results are embedded in HTML.

```
xu="3*u*(1-u)^2*p1+3*u^2*(1-u)*q1+u^3*5";
yu="3*u*(1-u)^2*p2+3*u^2*(1-u)*q2+u^3*(-5)";
fxy=Assign("[x,y]",["x",xu,"y",yu]);
cmdL=[
  "assume(g>0)",
  "fxy:"+fxy,
  "d2:diff(fxy[1],u)^2+diff(fxy[2],u)^2; n2:2*g*(-fxy[2])",
  "eq:ratsimp(sqrt(n2/d2)); tt:ratsimp(1/eq)"
```

```
];
var="eq::tt"; CalcbyMset(var,ans,cmdL,[""]);
```

Figure 1 shows one of these HTML screens. The question is displayed in the top left column, and the middle column is for the student's answers. The large points in the right-hand image are control points that can be moved freely. Press the Play button, then the mass will move from the top left to the bottom right. When the descent is complete, the time and the coordinates of the control point will be displayed on the screen.

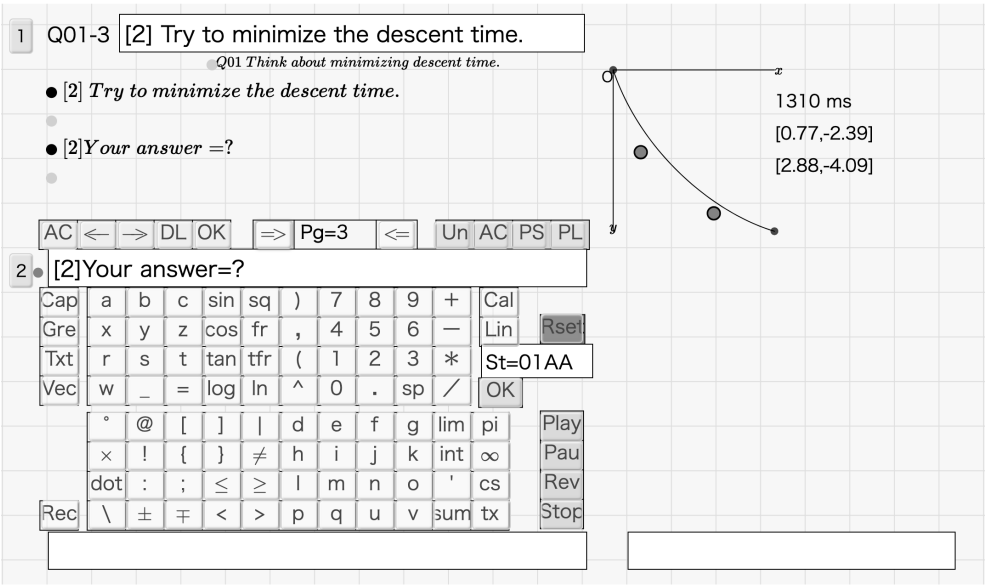

Fig.1 Screen of KeTLTS

3 Conclusion

Students use this material by competing with their friends as if playing a game. Maxima cannot grade answers that are expressed as mathematical formulas, but Algebrite, which runs on HTML, can check simple mathematical formulas and is effective for this teaching material.

References

[1] S. Takato, What is and How to Use KeTCindy–Linkage Between Dynamic Geometry Software and Graphics Capabilities– , Mathematical Software ICMS, 371-379, Springer, 2016

[2] S. Takato, J. Vallejo, A. Prokopenya, KeTCindy/KeTCindyJS – a bridge between teachers and students, Computer Algebra Systems in Teaching and Research, ISSN 2300-7397.VIII, 132-146, 2019

[3] KeTCindy Home `https://s-takato.github.io/ketcindyorg/indexe.html`