Melody and Zak,

Your presentation to the class on the project was quite good. I know that talking about mathematics in a language that is not your first language is hard. But I thought you got across the main points in a way that was very understandable for the class. Because you didn't have a way to show the animations in the paper, though, the paper was not quite as good. Instead of the animations, it would have been better to try to give a more complete description of what was happening in your examples, and maybe include graphs of one "frame" of the animations to illustrate what you were saying. The main things I would have liked to see more of was an analysis showing how the particular examples fit into the general sort of classification from Grashof's theorem, and then some different types of examples showing how the "end-effector" does not always reach all points on the coupler (Watt) curve. In other words, I think you didn't have enough time to do more experimentation and the limited examples you had did not really exhaust what the possibilities are.

Specific Comments

1. The terminology should be explained more clearly here. A side rod is called a *crank* if it can rotate through a full circle relative to the fixed rod (i.e. around the joint where it connects to the fixed rod). Similarly, a side rod is called a *rocker* if it can only rotate through a range of angles less than a full circle around the joint where it connects to the fixed rod. I think I know what you meant in the sentence "If all four links become connected, then there is a change point." But this is not clear and it calls for further explanation. I think you are referring to the configurations from which it is possible to move the mechanism in more than one way. These are examples of the *kinematic singularities* studied in Section 3 of Chapter 6 of IVA. (I think you could have used some of the ideas in the first three sections of Chapter 6 more than you did!) Also, where did the table on page 6 come from? If you were taking this from another source, you should cite it (and put it in the list of references).
2. Since you were using a different naming system for the lengths of the rods in the four-bar mechanism, Figure 2 is rather confusing. It would have been much better to make a figure yourself showing the naming you were going to use.
3. The discussion of the 3RPR parallel manipulator does not really relate to the rest of what you were doing (except as an example of a different type of mechanism). It would have been OK to leave that out, since it was not adding anything to your main points.
4. As I indicated above, even though you can't show the animations in the paper, it would have been really good to show one or two frames of the animations to show how the different solutions of the quadratic equation for n do give motions tracing out the whole coupler curve in the cases $a = 1, b = 3, c = 2, d = 4$ and also in the case $a = 4, b = 3, c = 4, d = 3$. Both of these are the "Case 4" of the table on page 6. With the "changepoints" you can trace out the whole coupler curve (both components) with different motions. In that case, both siderods are also cranks, so both choices of n from the quadratic equation give double-crank motions. It would

have been good to try more different possibilities guided by the table(!) For example, $a = 1, b = 3, c = 4, d = 3$ is "Case 2" in the table. If you plot the coupler curve, you'll see that it splits into two disconnected pieces. Depending on the choice of n from the quadratic equation, you can reach every point on either part, but there are no "changepoints" and both of those motions are rocker-crank motions (the side of length 4 cannot rotate through a full circle). See the attached figures. It would have also been really interesting to work out one of the "double rocker" motions from case 3 of the table.

Final Project Presentation: 92 (A-)

Final Project Paper: 85 (B)