Journal of Nam Nguyen for Spring quarter 2008

Nam Nguyen

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1 Weeks of May 25th and June 2nd,2008

These weeks came with the *"Student posters"* event. The poster session went quite well and I earned something through it:
- Use simple words to describe the problem: Some people didn't really understand the meaning of a tensor or rank of a tensor, but they could get it easier when I told them to understand in term of *points*.
- Pictures are very helpful: People could understand the problem easier when I described it through pictures.
- Applications: Some people asked me "What are its applications" and I coudn't clearly answer them.

2 Week of May 18th,2008

This week I worked on preparing the poster for the upcoming even. This poster consists of two parts of Krisnsha and I and we are going to have it done by next week. Besides, we tried to get some pictures of D_3 with the new base points.

3 Week of May 11th,2008

We found out the shape of Rcore (and also Score) of G_3 in an 3D space. Next, we started working on D_3 which can be represented by

$$D_3 = \left[\begin{array}{cc|cc} 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{array} \right]$$

$$\left[\begin{array}{cc|cc} 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{array} \right] + \left[\begin{array}{cc|cc} 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{array} \right] + \left[\begin{array}{cc|cc} 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{array} \right]$$

$$= e_1 \otimes e_1 \otimes e_1 + e_1 \otimes e_2 \otimes e_2 + e_2 \otimes e_1 \otimes e_2$$

with these base points, we are going to have pictures of D_3.

4   Week of May 04th,2008

We found the equation of the curves by solving $R_{core} = 0$ and $S_{core} = 0$. Surprisingly , we got $R_{core} = S_{core}$ for all the (x,y) points where

Rcore $= -2\,a_1\,a_2{}^2 a_0 + a_0{}^2 a_2{}^2 - 4\,a_0{}^2 a_2\,a_1 + 4\,a_0{}^2 a_1{}^2 - 4\,a_0\,a_1{}^2 a_2 + a_1{}^2 a_2{}^2$

Score $= -2\,a_1\,a_2{}^2 a_0 + a_0{}^2 a_2{}^2 - 4\,a_0{}^2 a_2\,a_1 + 4\,a_0{}^2 a_1{}^2 - 4\,a_0\,a_1{}^2 a_2 + a_1{}^2 a_2{}^2$

and the R_{core} (or S_{core}) in terms of (x,y)

Rcore $= \frac{1}{s^4} \times (-2\,yx^2 s^3 - 2\,ys^3 x + 10\,y^2 x^2 s^2 + 4\,y^3 xs - 2\,sc^2 y^3 + 2\,y^3 sc + 2\,sc^3 y^3 + s^2 c^2 y^2 + 4\,yx^3 s^3 - 2\,y^2 s^2 x + y^2 s^2 - 2\,y^3 s - 4\,xsc^3 y^3 - 4\,x^3 s^3 cy + 6\,x^2 s^2 c^2 y^2 + 12\,xsc^2 y^3 - 2\,xs^3 cy + 6\,x^2 s^3 cy - 6\,xs^2 c^2 y^2 + 2\,s^2 cy^2 - 4\,y^4 c + 10\,c^2 y^4 - 4\,c^3 y^4 + x^2 s^4 - 2\,x^3 s^4 + x^4 s^4 + c^4 y^4 + y^4 + 4\,xs^2 cy^2 - 20\,y^3 xsc - 12\,x^2 s^2 cy^2)$

For the next part, we are going to visualize what the shape of R_{core} (or S_{core}) looks like and prepare a poster.

5   Week of April 28th,2008

We're trying to predict the equations of the curves that appeared in the picture we got last week. Unfortunately, it was somehow more difficult than we thought since some rank 2 approximation points with lighter colors also lie close to the curves. But there are two things we learned from the picture:

- The three based points

$$B_1 = \left[\begin{array}{cc|cc} 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{array}\right]$$

$$B_2 = \left[\begin{array}{cc|cc} 1 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 \end{array}\right]$$

$$B_3 = \left[\begin{array}{cc|cc} 0 & 0 & 0 & 1 \\ 1 & 1 & -1 & 1 \end{array}\right]$$

are all on the curves since there R_{score} and S_{core} are all zeros. So the equations must first be satisfied at these based points.

- The last "curve" is not completely a curve. It looks like a straight line, or in other words, a linear equation. It's strange because the other ones are curves. There are two approaches we plan to work on in order to find the equations. The first one is to analyze the images but it doesn't make sense since there were noises on the images. The second one is to get the plotting data, simplify it to get the points lying on the curves and then fit them with a function.

6   Week of April 21th,2008

We found the picture, finally, but it wasn't as good as we wanted it to be. We didn't get holes as we expected but there were three curves in the pictures and we wanted to know their formulas. Our guesses are the quadratic conics and this should be what I'll focus on this week.

7 Week of April 14th,2008

This week we worked on coding to get some pictures of rank-3-tensor approximations. After a discussion with Dr. Martin, we made some changes to the code and hopefully we can get these images this week or next week.

8 Week of April 07th,2008

This week I read section 5 and 6 of the paper *"Tensor Rank And The Ill-posedness Of The Best Low-rank Approximation Problem"* - *V.De Silve and L.H. Lim.* Theorem 7.1 classified the orbits of all tensors in $GL_{2,2,2}(R)$. Based on this Theorem we are going to make some pictures of rank-3-tensor approximations of G_3 whose formula is

$$G_3 = (e_1 + e_2) \otimes e_2 \otimes e_2 + (e_1 - e_2) \otimes e_1 \otimes e_1 + e_2 \otimes (e_1 + e_2) \otimes (e_1 - e_2)$$

8.1 Todo things

In next week, I plan working on coding to plot the pictures.