# Double Star Occultation analysis using LiMovie

**TTSO 8, Melbourne, Monday 21 April 2014**

*[If these notes are being used while viewing the Power Point presentation, use the pps (F5) mode and advance at each number bold header in the text. There are 27 frames altogether, but many include changes built in.]*

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This is an introduction to the use of Limovie for the analysis of double star lunar occultations observed using video. It follows on from the introductory talk on Friday and is aimed principally at those new to reporting double star occultations.

Limovie can be downloaded through the RASNZ Occultation Section website: http://www.occultations.org.nz. Work down to near the bottom of the yellow index on the left hand side. Or directly from: http://www005.upp.so-net.ne.jp/k_miyash/occ02/limovie_en.html. A manual written by Dave Herald is also available.

**1. Opening Screen of Limovie**

NB does not normally have this text!!

**2. Reappearance of a Double Star**

For this presentation I am going to consider the reappearance of the double star X146551/X43112 on 2013 February 6. The first frame shows the moon's Earth lit limb just before the reappearance started. The waning moon was 17% lit. (This is a KIWI-OSD time display, not IOTA-VTI.))

**3. First star to reappear X43112, the fainter star.**

The magnitude of this component is given as 10.0. The time of this frame was 16:28:28.029

**4. Second star to reappear, X146654, the brighter star.**

The brighter components magnitude is given as 9.11. The frame time 16:28:29.269

**5. Setting measuring tool:**

Since this is a reappearance, it is necessary to step forward though the video until the first frame with the star at full brightness is reached. As previously choose "Lunar Occultation – bright star, drift track"

**5a Measuring tool size:**

For this event I increased the size of the measuring radius from 4 to 5 and the inner distance to 7.as there was slight image movement.

**5b. Step back:**

When set, step back to a few seconds before the reappearance. (Avisynth can be used to run through the video backwards, but I find this works as well.)

**5c. And click on Start:**

Limovie runs through taking measures of the image intensity.

## 6. Light Curve

When finished generate the graph. Clearly a double (stepped) event, the relative heights of the steps show the fainter star was first to appear.

## 7. Select points to get times:

Click on last point with no star. Time is 16:28:27.950; similarly click some other key points.

**7a. Click first point of step** Time is 16:28:27.990

**7b. Click last point of step** Time is 16:28:29.229

**7c. Click first point of full star** Time is 16:28:29.269.

It is a good idea to note these times and …

**7d. calculate the time of the first event:** 16:28:27.97**…and the second:** 16:28:29.255

## 8. More from light curve – selecting some points

Click on a point about the middle of the step Point Selected here is frame 160

**8a. Click on the Diffraction button**

## 9. Choosing the point range.

A new screen is produced with a data panel on the right.

Some points on the light curve have been selected, shown in green. Some of those selected are on the step, some on points either before or after the step.

**9a. Positions of selected points,** relative to the red selected point, are shown in the panel.

**9b. Move the selected points onto the before and after regions only**

The points selected need to be changed so that none of them lie on the step. Do this by using the left/right arrows under "before" and "after". The number of points selected can be increased if wanted.

## 10. Points before and after

The selected points are now clear of the step. Their ranges are shown in the data boxes – from 18 to 62 points before the selected point and from 18 to 62 after the selected point. For what it is worth, if possible avoid including small jumps in the level. It is not essential to have the same number of points before and after.

**10a. Points for the step itself can be selected in the same way.** Use the 'step' arrows: the lower set control points left of the selected point, the upper set those after.

## 11. Step points selected

It is probably usually best to select all the step points, sometimes there are few, but don't include any intermediate points.

On the left of the data box the mean light levels of the selected points are shown. In this case read from bottom to top.

**11a. Add Identification**

At this point we will divert and add the star, date and observer data. If left to later , it may get lost again. Click the Identification button.

**12.** **Adding identification**

This was described in my previous talk.

**12a. The data entry panel** shows the sort of data needed**.**

**12b. Click on Apply** this adds the identification data to the light curve, at the top left corner in recent editions of Limovie.

**12c. Now click on "magnitude calc"** to get more info about the star magnitudes

**13.** A new panel appears, down in the lower part is statistical data showing the mean light at the various stage of the event.

**13a. Some magnitude data** is shown in the top right corner, shown enlarged. You will see that at present the combined magnitude of the pair is taken as 0.0. The magnitudes of the two stars as determined by the light levels differ by 1.05 magnitudes. The combined magnitude of 1.40 and 0.35 is 0.0.

Clearly the true combined magnitude of the stars is not 0.0! This can be changed.

**13b. Use the up/down keys** to dial in the actual combined magnitude, in this case taken as 9.1 as shown in Occult.

**14.** **Magnitudes displayed**: Now the determined magnitudes are displayed, 9.45 and 10.50, still differing by 1.05, The catalogued magnitudes are 9.11 and 10.02, so differing by 0.91. (Combined these give 8.72)

**14a. To add data to the light curve** click on "transparent background"..

**15.** Re-p**osition text on graph:** This places the text in the upper right part of the screen. It may overlap some of the light curve.

**15a. Use the sliders** to move the text to a suitable place.

**16.** **Text in position -** Close the Magnitude Calculator Window

**17.** **Save the graphic** with the added text by using one of the buttons:

**17a. Either Save Image or use Copy to Clip Board** if you want to include it in a double star report.

**18.** **Questions** on anything so far?

The second part is on forming and sending the double star report.

**19.** **Occult's Observation Editor:** Part of the month's observation listing. If a double star occultation is observed the times of both steps should be included as two separate lines

**19a. Entries for double star:** Both occultations events are shown (lines 6 and 7).

**19b. The time difference in the seconds** of the two occultation is going to be needed. This is in the sense time of faint – time of bright.

**19c. A and B** are used to distinguish the components of a known double, the primary, A star here reappeared second. Only used if the prediction shows A and B.

**19d**. **Also F(ainter) and B(righter)** are used to distinguish the type of event. East and West or North and South are also available.

**20.** **Select the brighter component** to form the double report. In this case this is the second star to reappear

      **20a.** **"Brighter component" and "A"** are shown for this component on the edit screen.

      **20b.** **Click on Double Star Report** on the menu bar

**21.** **Click "Create Report** …" Occult makes sure you know to select the brighter component. If you have selected the wrong star hit "escape" go back and select the brighter!

**22.** **The Double Report screen**. On the left almost all the necessary data needed is filled in for you.

      **22a. Seconds of time for brighter star.** Among the data is the time for the brighter star. All that is needed is the time difference for the two events.

      **22b. Enter the time difference:** in the sense time of fainter component minus time of brighter component.

      **22c If this is a suspected double and no step is seen**, tick the box instead.

**23.** **Time entered:** note that Occult shows the seconds of time for the fainter component below the difference so giving a check that it the difference entered is correct.

      **23a** **Click retrieve Limovie plot** – if it is in the clip board.

**24.** **Report ready to email:** it can be formed in less time than I took to describe it!

      **24a.** **A message about the event can be added**

      **24b.** **Check that an email for me is shown in the box.** If not enter one.

      **24c.** **Click on Save and email report.** The report and attached light are sent by Occult to me.

      If the email fails, save the report and make it the text of an email and attach the light curve.

**25.** **The email report I receive.**

**26.** **Light curve attachment**

      Both are archived. You should normally receive an acknowledgement within 48 hours. It will contain information about any other reports I have for the double star.

**27.** **Questions?**