

# Historical Video Documentation of Triangulation Measurements in Finland

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**Key words:** History, triangulation, Maupertuis, Struve, video documentary

## SUMMARY

We describe the making of a historical video documentary of the survey triangulation measurements in Finland. Video is focusing to triangulation measurements made by Maupertuis, Struve and the Finnish Geodetic Institute.

We realized that it would be the last moments for making a documentary film. Many people who participated in the measurements have already retired and knowledge is disappearing with them. Modern Technologies, like GPS, have replaced old triangulation measurement techniques.

Our documentary movie, called “TRIANGULATION -the basis of mapping in Finland”, demonstrates measurement methods like invar wire, angular and astronomical measurements. Experts who have been involved in the triangulation campaigns present the methods. The movie also shows old photographs and written documents from the archive of the Finnish Geodetic Institute. The aim of the movie is to increase general knowledge concerning the subject and to preserve this important part of sciences cultural heritage. Material was filmed in the summer and autumn of 2006 and edited in year 2007. During the spring of 2008 the documentary has also been translated into English.

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## 1. INTRODUCTION

### Aim of the Documentary

The aim of the documentary is to increase general knowledge about the history of surveying and especially the history of triangulation. Triangulation measurements have great historical and scientific importance. It is part of national and international cultural heritage that deserves to be documented.

We realized that it would be the last moment to make a film about the issue, because many people who have been involved in the measurements have already retired. We wanted to preserve this historical and scientific cultural knowledge in a popular format so that everybody can understand the meaning of measurements.

The issue was found very significant for Finnish culture of science. The Finnish Cultural Foundation funded mainly our project and therefore helped us to preserve this important part of science and surveying cultural heritage in Finland.

The movie was filmed in cooperation with the Finnish Geodetic Institute (FGI) and experts in the documentary are scientist or retired scientists of the Institute. Most of the historical material is from archives of the Finnish Geodetic Institute.

### Long History of Triangulation Measurements in Finland.

Triangulation is an old scientific method to measure the shape of the Earth. In Scandinavia there have been two worldwide well-known historical triangulation measurement campaigns. In 1736-37 French Count Pierre-Louis Moreau de Maupertuis measured a triangulation network in the Torne River Valley in Lapland. Maupertuis aim was to measure the shape of the Earth.

The second significant triangulation campaign was planned by astronomer Friedrich Georg Wilhelm Struve. Struve's Geodetic Arc is a chain of triangles starting from the Black Sea and extending through Europe and Scandinavia up to the Arctic Ocean. Measurements were carried out between 1816 and 1855. The cultural, scientific and historical significance of Struve's Arc was acknowledged in 2005 when the Arc was accepted to the World Heritage list of UNESCO. (UNESCO, 2008)

In the 20<sup>th</sup> century there was a significant national triangulation project in Finland. Measurements of the Finnish First-Order Triangulation network were carried out between

years 1919 and 1987. Finnish coordinate reference frames were based on that triangulation network and these frames are still widely in use in Finland.

In the late 1980's space-geodetic measuring methods and especially the use of GPS displaced triangulation in a very short period of time. In Finland the same work that took almost 70 years by the means of triangulation, could be completed with GPS in a couple of years.

## **2. PRODUCTION PLAN**

### **Production Group**

Manuscript, filming, editing and post-editing was done by Jyrki Puupponen (FGI) and Jaakko Järvinen. Experts in the documentary are Ph.D Matti Ollikainen, emeritus Professor Jussi Kääriäinen and Professor Markku Poutanen from FGI. Matti Ollikainen made astronomical observations during many summers in the 1970's and 1980's. Jussi Kääriäinen was observing angles in 1970's and 1980's. Markku Poutanen was also observing angles in 1980's. Matti Ollikainen and Jussi Kääriäinen made invar wire measurements during decades.

Narrators in the Finnish version of the documentary were Risto Järvinen and Markku Poutanen. Narrator in the English version of the documentary was Ken Pennington (Helsinki University of Technology, TKK). Assistant people in filming were Pasi Häkli (FGI), Jorma Jokela (FGI), Anna Eving (TKK), Tapio Poutanen, Jani Uusitalo (FGI), Hannu Koivula (FGI), Maaria Nordman (FGI) and Marko Patovisti.

We would like to thank for cooperation also Erkki-Sakari Harju (Affecto), Risto Kuittinen (FGI), Henrik Haggrén (TKK) and Martin Vermeer (TKK).

### **Filming Arrangement and Manuscript**

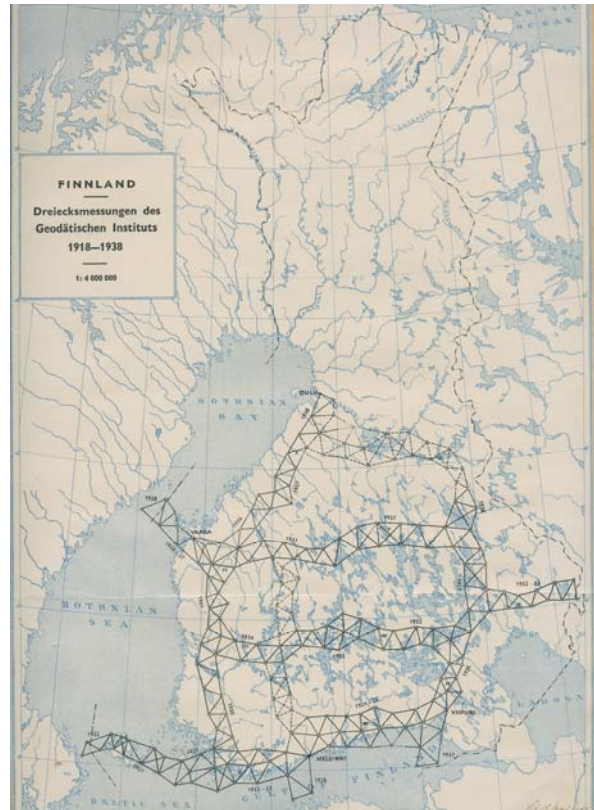
Planning and scheduling of the documentary was masterminded with experts during 2006. Also the concept of documentary was discovered. We explored the archive of the Finnish Geodetic Institute. The issue was very comprehensive because it deals with a long period of time and triangulation techniques are very complicated. We wanted to make a film in popular format and we were therefore forced to eliminate some details. We needed to consider carefully what and how to present triangulation techniques.

The Finnish Geodetic Institutes archives contain many old photographs (Figure 1), written documents and maps (Figure 2) about triangulation measurements in the 20<sup>th</sup> century. We scanned tens of photos for the movie and used old maps to understand how measurements proceeded during the decades. Written documents helped us to find out the character of the job. Also the experts who participated in the original triangulation measurements helped us to understand the nature of triangulation.

The first version of the manuscript was done in summer 2006 and filming arrangement could be started. The manuscript was further refined during the editing process.



**Figure 1.** Angle measurements in Oulu in 1939. Photograph is from the archive of the Finnish Geodetic Institute.



**Figure 2.** During decades measurements proceeded to the north. First order triangulation network measured during 1918-1938. Map is from the archive of the Geodetic Institute.

### Filming the Documentary Movie

Filming the demonstrations of triangulation methods were done during the summer and autumn of 2006. Filming was done in the Finnish Geodetic Institute, in Nummela and in Puolakka. In Nummela there is the standard normal baseline of Finland. Nummela was the perfect place to demonstrate invar wire measurements, because the poles used for original wire calibration measurements were still present (Figure 3).

In Puolakka there is a triangulation tower, which has been constructed for the memory of triangulation measurements. The tower was a good place to demonstrate the angular measurements (Figure 4). Astronomical observation was demonstrated in the yard of the Finnish Geodetic Institute.



**Figure 3.** Jussi Kääriäinen and Matti Ollikainen demonstrated invar wire measurements in Nummela. (Photo Pasi Häkli)



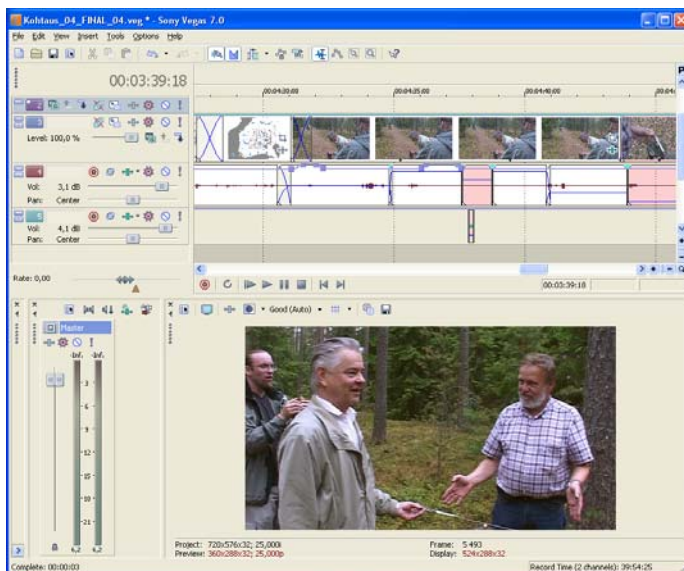
**Figure 4.** Jussi Kääriäinen demonstrates angular measurements in Puolakka. (Photo Markku Poutanen)

Filming was done with two cameras. We used Sony DRS-PD150P MiniDV –camera and the Sony HVR-A1E HDV-camera. Recording format was MiniDV. Over twenty hours of material was recorded during the filming process.

### 3. POSTPRODUCTION OF THE DOCUMENTARY

#### Editing

Editing the film was done mainly during the year 2007 with Sony Vegas 7.0 software. Sony Vegas is professional editing software (Figure 5).



**Figure 5.** Sony Vegas 7.0 software was used for video editing.

Editing was definitely the largest part of the project. We used huge amount of time just to go through the raw video (over twenty hours). Every single minute in the documentary required several hours of editing work. In practice editing was done in small sequences (scene) that were later combined together.

### **Recording Narration, making Animations, Translation, Soundtrack and Dvd Creation**

Triangulation techniques are quite difficult to understand, so we decided to simplify and clarify methods with animations. Animations were designed and produced during the editing process. Narration was recorded and it was attached to the movie. Also a soundtrack was produced for the video.

The final phase was to combine all parts together. We also showed earlier versions of the documentary to experts to get some comments. Only minor changes were needed. The final version of the movie was then rendered to DVD-format (mpeg) and a DVD was prepared with Sony Architect 4 software.

## **4. CONCLUSION**

In this paper we have described the main phases of making a documentary film about triangulation measurements in Finland. Even though the project was enormous it was still very interesting and educative. The original language of the documentary movie is Finnish, but we decided to prepare also an English version. A native English speaker was hired as narrator for the English version of the documentary.

A short trailer of the film is on the webpage <http://www.praktiikka.fi/Kolmio/>

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