e-Perimetron, Vol.1, No. 4, Autumn 2006 [287-296] www.e-perimetron.org | ISSN 1790-3769

Miltiadis Daniil*

Comparing by digital transparency the differences between two almost identical 17th century maps of North Aegean Sea

Keywords: Cartographic heritage; History of maps; 17th century cartography; J. Laurenberg; O. Dapper; J. van Meur; North Aegean; digital map comparison; digital transparency.

Summary
In 17th century J. Laurenberg as *autore* and O. Dapper, with J. van Meur as *autore*, issued two almost rectangular maps of the North Aegean. The first one, in colours, with dimensions 49X59 cm and the second monochromatic with dimensions ca 1,5 times smaller (32X37 cm). Apart of the dimensions, colours, lettering and decoration apart, the two maps are of exactly the same geometric and thematic content, the Meur's copy looking as a reduced exact reproduction of Lauremberg's map. In this paper, after having transformed the two maps in digital form, we use the *digital transparency* technique to study the differences of these two maps, developing a proper comparison method for this purpose, which can be generalized in any problem of this type in the domain of history of maps.

Introduction

In 17th century, two maps of the North Aegean Sea appeared under the same title *Insularum Archipelagi Septentrionalis seu Maris Aegaei Accurata Delineatio.* The first coloured with dimensions 49X59 cm, with J. Laurenberg as the *autore*, is catalogued by Zacharakis (1992: 101) under J. Laurenberg[1] and the second monochromatic with dimensions 32X37 cm, with J. van Meur as the *autore*, is catalogued by the same author (Zacharakis 1992: 72) under O. Dapper[2].
The Laurenberg map belongs to a series of six maps[3] representing the major part of the actual territory of Greece (Fig. 1, Fig. 2) which are documented in Zacharakis (1992: 303-305) with all relevant information about the appearance of this map in various Atlases[4] from 1638 to 1741. The Dapper/van Meur map together with the relative map of Cyclades[5] (Fig. 3) belong to Atlases of the Aegean Sea documented in Zacharakis (1992: 255) which appeared from 1688 to 1730.
These two maps[6], the dimensions, colours, lettering and decoration apart, look identical as far as their geometric and thematic content is concerned. In other words the Dapper/van Meur copy seems that was derived after an exact geometric reduction of Laurenberg's map, on which then some changes were applied mainly in lettering and decoration, including the quite different concept and ideology of the cartouche as depicted in the two maps (Fig. 4).

---

* Ph.D. Candidate, Department of Architectural Engineering, Democritos University of Thrace, Greece. [mdaniil@arch.duth.gr]

[1] Zacharakis Cat. No. 1276

[2] Zacharakis Cat. No. 879

[3] Zacharakis Cat. No. 1277, 1278, 1279, 1280, 1281

[4] By J. Janssonius, G. Hornius, Allard, Visscher, van Waesberg.

[5] Zacharakis Cat. No. 880

[6] In this study it is postulated that the Laurenberg map precedes chronologically the Dapper/van Meur map

Figure 1. J. Laurenberg. Up left to right*: Macedonia Alexandri M. partia, Thessaliae, Insularum Archipelagi Septentrionalis seu Maris Aegaei* (in red frame). Down left to right: *Epirus, Achaiae, Archpelagi Meridionalis seu Cycladum Insularum.*

Figure 2. The six Laurenberg maps of Fig. 1, cover the major part of the actual territory of Greece. Due to overlapping, the maps are optimally fitted in a single 'continuous' map. The scale differences in each map are more than evident.

The apparent similarity of the two maps was the starting point for a systematic comparison of the two maps, concerning their geometric and projective properties, in order to understand the apparent technique used by Dapper/van Meur for the copying of Laurenberg map. The comparison was carried out using the 1:1 digital copies of the two maps and the technique of the so called *digital transparency* (Livieratos 2006: 74) which is a powerful tool for the comparison of two, or more, digital image files, when are properly best fitted, according to rigid transformation models ensuring optimality (Boutoura and Livieratos 2006: 60).

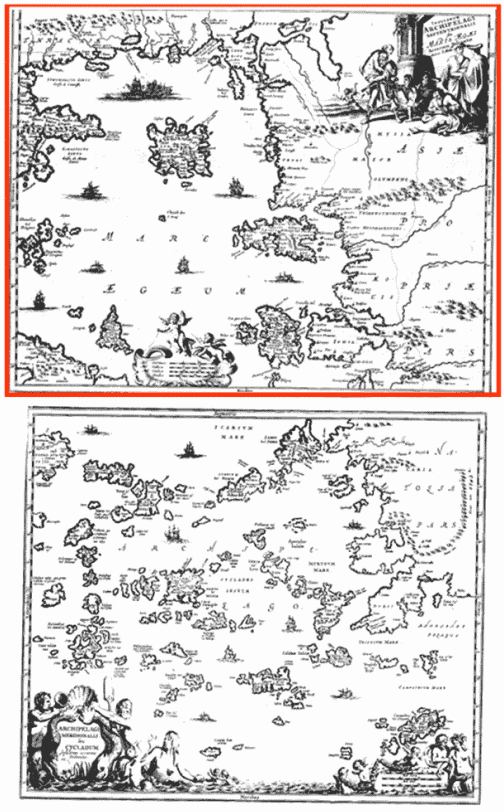

Figure 3. O. Dapper / J. van Meur.
Up: *Insularum Archipelagi Septentrionalis seu Maris Aegaei* (in red frame).
Down: *Archpelagi Meridionalis seu Cycladum Insularum*.

Figure 4. *Insularum Archipelagi Septentrionalis seu Maris Aegaei*
Left: The cartouche in Laurenberg's map. Right: The cartouche in O. Dapper / J. van Meur's map.

The comparison process

The process followed in this comparison test is illustrated in Fig. 5. The two maps L (for Laurenberg) and D (for Dapper/van Meur) taken in their 1:1 digital form[7] were first transformed into a common scale, that of map D (the smaller scale), applying a similarity (conformal) transformation of L into D (the transformation allows only a uniform scale and only a universal rotation change).

[7] The digital 1:1 copies of the two maps were kindly offered by the Hellenic National Centre for maps and Cartographic Heritage.

A new digital version L′ of L is thus obtained, in the same scale with D, while due to this transformation all shapes on L are kept unaltered on L′.

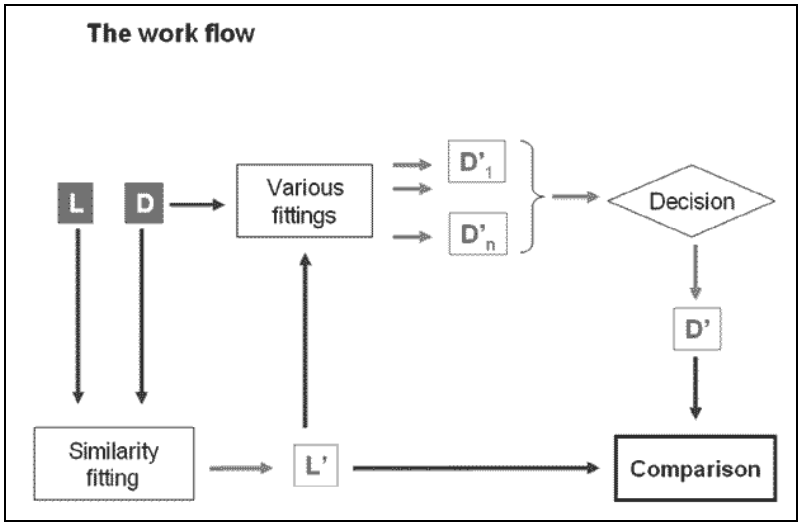

Figure 5. The comparison process.

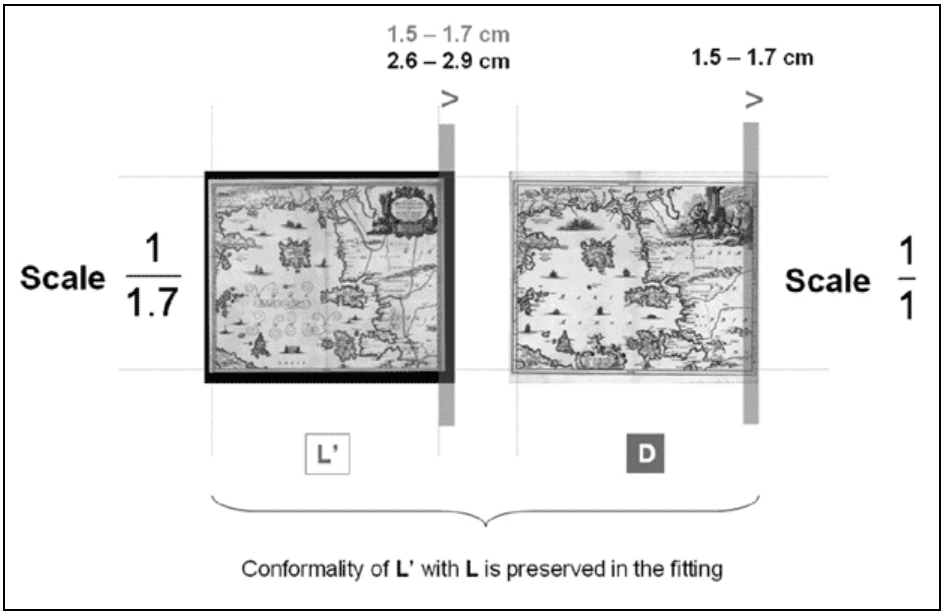

Figure 6. The result of transforming similarly L into D, to obtain L'. L' (left) and D (right) have now exactly the same dimensions. The scale of L' is 1:1,7 with respect to the 1:1 of the original L and the utile map content of L' is almost 3 cm shorter than that of D.

The reduced map L′, conformal to L, is optimally fitted to D, having now the same scale as D which is 1,7 smaller than the scale of L.

Another very interesting result, as it comes out from this transformation, is that after the almost 40% reduction of Laurenberg map in order to get the Dapper/van Meur copy, a 1,5 to 1,7 cm column strip was added by the copyist, at the right-end side of the reduced copy. This figure corresponds to a 2,6 to 2,9 cm additional missing column strip at the right end side of the Laurenberg map (Fig. 6). Obviously this additional strip served in Dapper/van Meur copy for the drawing of larger and more impressive cartouche at the map upper right corner. As it is shown in Fig. 7, the strip added in D was then drawn as a continuation of the missing part in L.

Figure 7. Left: The 1,5-1,7 cm strip added at the right-end side of D map (shaded) after the 40% reduction of L. Right: The relevant detail in the digital transparency view of the fitted L' and D images.

Having now available in the same scale D and L′, the conformal image of L optimally fitted to D, a comparison analysis is carried out according to various fitting transformations used in the analysis of the geometric content of old maps In this step, D is transformed into L′ using the adopted fitting process obtaining thus, the D′ image best fitted to L′ (Fig. 5). Finally the D′ and L′ images are compared using the *digital transparency* technique which is available in image processing software available in market. The digital transparency is obtained when in two perfectly overlapped image layers the opacity of one of them is diminished. Following this technique, which is actually a novel tool in comparison processes thanks to modern digital technologies, a powerful tool is available for the deformation analyses of the geometric and projective content of old maps.

The fitting schemes for the comparison

In the following, the digital transparency shows how this powerful tool helped considerably the comparison of the two images L′ and D′, using some known transformation schemes in order to fit optimally D into L′, getting in this way a set of D′ which are then compared to L′ with the use of digital transparency. The transformation models used are the affine, the 2nd and 4th order polynomials and the finite element model (Balletti 2006: 32, Boutoura and Livieratos 2006: 60). Keeping the affine fitting result, comparisons are carried out with the other three fitting results in order to study the properties of the Dapper/van Meur copy map with respect to the Laurenberg map.
For the better visualization of the fitting results and for the comparison, the technique of using arbitrary unit circles (Boutoura and Livieratos 2006: 63) is followed. The unit circles are assigned to points on D properly distributed on the whole surface of the image and eventual isotropic or

anisotropic alterations in the size and the shape of the circles, after the fitting into L′, will show the deformation effect due to the fitting.
In Fig. 8, four D′ images are shown, results of four types of optimal fittings of D into L′. The first very interesting results is that the unit circles used in order to visualize deformations, due to the fitting, remained practically unaltered both in size and shape which means that the copyist of Laurenberg map made an excellent work in keeping unaltered the shape of L in deriving D. In fact D is a perfect conformal copy of L with only a scale difference.

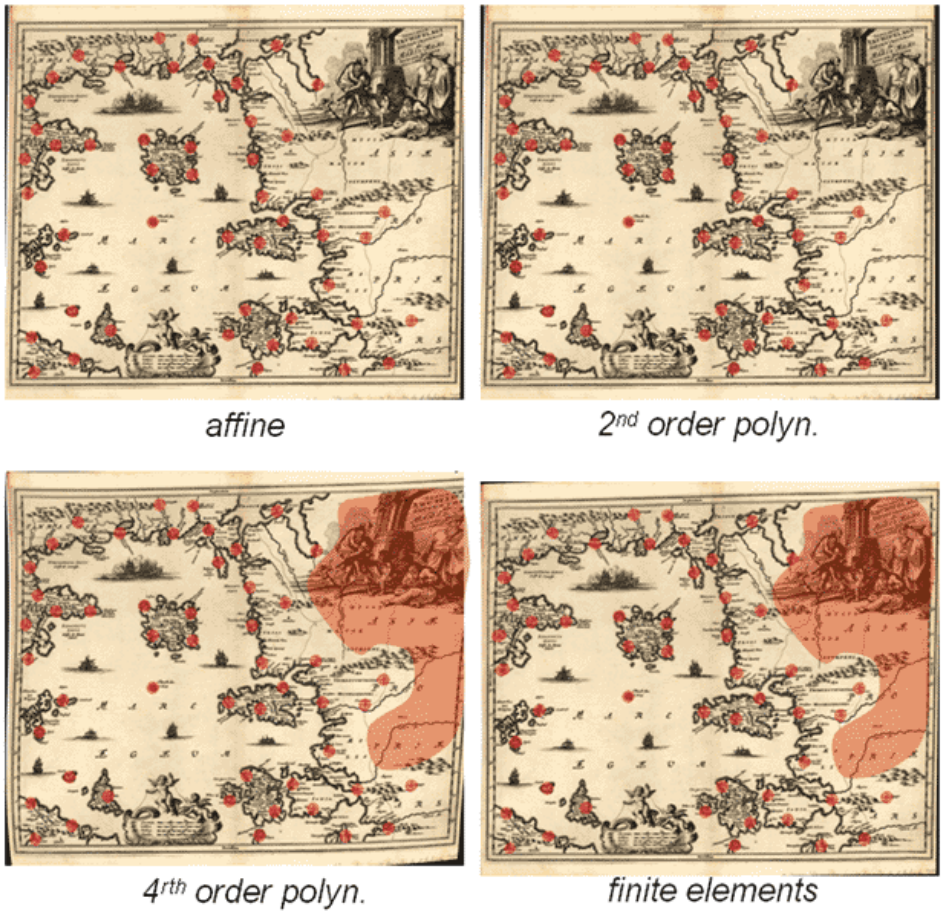

Figure 8. Four images of D' resulted from four models of fitting D into L'. The conformal relation of D with L is evident from the four model fitting, leaving unaltered the size and shape of the unit circles visualizing deformations. The shaded areas in the 4th order polynomial and finite element fitted images D' are obviously deformed because of the lack of control points to be used in the fitting process.

Comparison by digital transparency

The digital transparency is used for the study of deformations induced when the D image after having transformed to fit optimally the L′ image through an affine transformation (D′-affine) is compared with:

a) the optimally fitted D image to L′, through a 2nd order polynomial transformation (D′-2nd order polynomial), Fig. 9,
b) the optimally fitted D image to L′, through a 4th order polynomial transformation (D′-4th order polynomial), Fig. 10 (left), and
c) the optimally fitted D image to L′, through a finite element transformation (D′-finite element), Fig. 10 (right).

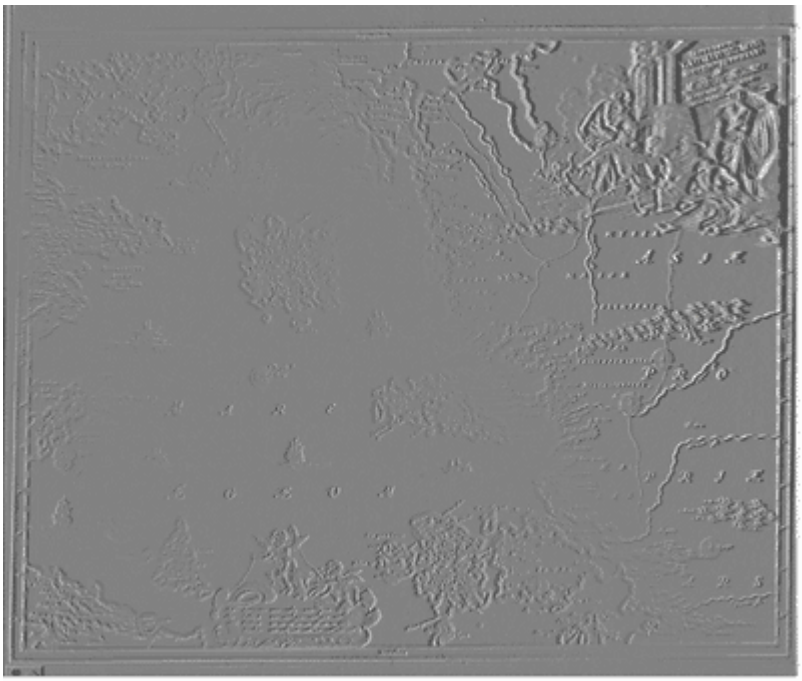

Figure 9. Digital transparency of the differences between D'–affine and D'–2nd order polynomial

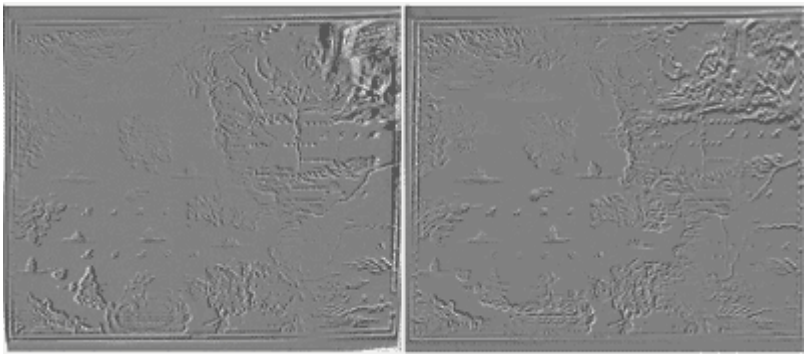

Figure 10 Digital transparency of the differences between: D'–affine and D'–4th order polynomial (left) and D'–affine and D'–finite element (right)

From the above comparisons, the first (Fig. 9) presents an almost perfect coincidence except the map areas where it is not possible to use common control points for the transformations, such as are the areas with decorations. The comparisons in Fig. 10 presents the same behaviour but with exaggeration in the areas with decoration.

In the next four images (Figs. 11, 12, 13, 14) the digital transparencies shows the comparison between L′ and D′–affine, in dark delineament the first and in white the second.

Figure 11. Digital transparency comparison between L' and D'–affine: The **upper left** detail.

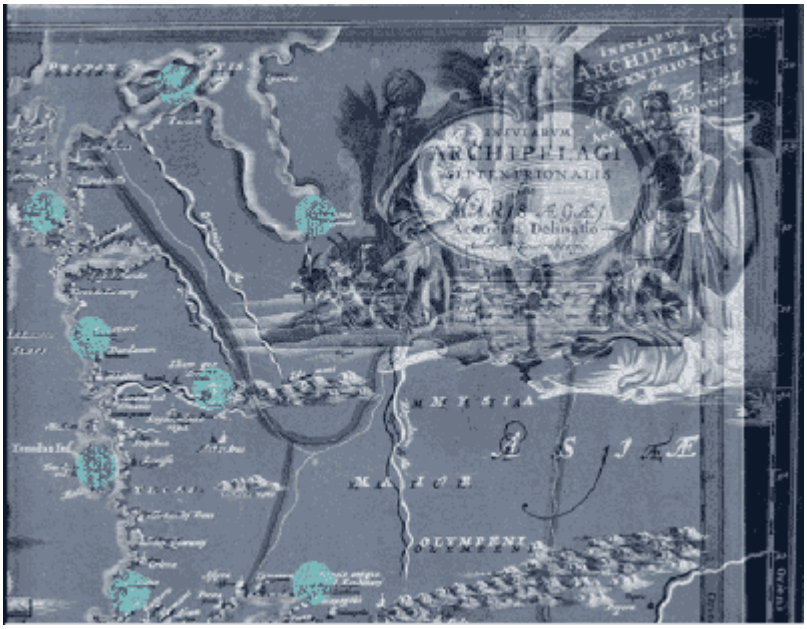

Figure 12. Digital transparency comparison between L' and D'–affine: The **upper right** detail.

Figure 13. Digital transparency comparison between L' and D'–affine: The **lower left** detail.

Figure 14. Digital transparency comparison between L' and D'–affine: The **lower right** detail.

The above four figures show the four parts (upper left, upper right, lower left and lower right) of the whole image. From these images it is evident that the copyist made on D, after the conformal reduction of L, a true copy of its geometric and projective content as well as the positioning of toponyms, changing only the lettering and the decorations, remembering, of course, the radical change of the cartouche which in the Dapper/van Meur map carries a strong and stressing historical and ideological message concerning the cultural tradition of the geographic area depicted on the map, recalling also its present state.

Conclusions

In this paper two similar 17th century maps of the North Aegean Sea of different dimensions, by Laurenberg and by Dapper/van Meur, are studied as far as their geometric content is concerned in order to evaluate the degree of their similarity. The two maps obtained in digital form were optimally best fitted using proper transformations and the final comparison was done using the digital transparency technique known from image processing. The results shows that the Dapper/van Meur map is a perfect conformal 1:7 reduction of Laurenbergs map and further unveiled that, after the reduction, a column-strip was added at the right-end of the Dapper/van Meur map, apparently for the drawing of a more impressive and imposing cartouche than in Lauremberg map. With this addition the longitude width is expanded, while the latitude height remains the same. Finally, thanks to digital transparency, the exact overlapping of the two maps shows that the geographic delineament of Laurenberg map remains almost the same in the Dapper/van Meur counterpart with the place names also at almost the same positions on the map, but with different lettering (calligraphy) patterns. In decoration, the Dapper/van Meur approach is much more artistically elaborated and dense, following a completely different aesthetic and ideological concept in designing the dominant cartouche at the same place as in Laurenberg map. The work-flow presented in this study can be easily applied and extended to any relevant case of map comparison showing that the digital transparency allows to extend the comparison process not only to the geometric part of the map content but also to its thematic counterpart.

Acknowledgement

Thanks are due to the Hellenic National Centre for Maps and Cartographic Heritage for providing, from its collection, the maps used in this study.

References

Balletti, C. (2006). Georeference in the analysis of the geometric content of early maps. *e_Perimetron,* 1 (1): 32-39 [In digital form www.e-perimetron.org].

Boutoura, C., E. Livieratos (2006). Some fundamentals for the study of the geometry of early maps by comparative methods. *e_Perimetron,* 1 (1): 60-70 [In digital form www.e-perimetron.org].

Livieratos, E. (2006). The use of animation in visualizing deformations of a portolan-type map. *e_Perimetron,* 1 (1): 71-76 [In digital form www.e-perimetron.org].

Zacharakis C. G. (1992). *A Catalogue of printed maps of Greece 1477 – 1800.* Athens: Samourkas Foundation.