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Georeferencing Old Large-Scale Maps from a Research on Historical Routes Perspective

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I. INTRODUCTION AND RELATED WORK

Old large-scale maps are important information sources for research on georeferencing historical routes. This research is largely supported by local researchers working in the terrain. They georeference map entities such as cadastral units, boundary stones, and wayside shrines by hand. Such groundtruth data is valuable for the development of new digital map processing algorithms. By characterizing those georeferencing and disambiguation tasks we outline potential requirements for algorithmic solutions.

Understanding text and georeferencing entities of large-scale historical maps is still in its infancy. More focus lies on the segmentation and the matching of labels and markers (see e.g. [1]). Research on historical route networks and travel itineraries is often concerned with the georeferencing of route stops only. As a particular algorithmic approach, we address the georeferencing of route stops denoted by historical place names in [2]. The algorithm input is a sequence of place names and distance estimates between them as e.g. explicitly contained in mile disks and maps with mile dots (see Fig. 1a and 1c). Weinman [3] targets the georeferencing by aligning toponyms on maps and those from a gazetteer through a probabilistic model. Georeferencing maps using image processing based on line segment features is e.g. addressed in [4]. Tools for georeferencing historical maps in their entirety¹ and for the display of map overlays² exist. However, there is a need for more automatic approaches and an in-depth georeferencing.

II. GEOREFERENCING HISTORICAL LARGE-SCALE MAPS

The georeferencing of historical routes relies on an in-depth georeferencing of old large-scale maps. We distinguish four properties useful for the disambiguation of map entities:

Textual: Place names on old maps (e.g. names of lakes, rivers, roads, settlements) might match with gazetteer entries and ambiguities might have to be resolved (see e.g. Fig. 2 and the ambiguous *Steinbach* present in GeoNames). Historical spelling must also be addressed such as for *Eyersheim* (see e.g. [2] for algorithms). A special challenge arises from place names of locations that no longer exist (see e.g. Fig. 2: the abandoned village *Wettenburg*), and from unpopulated places

(see e.g. Fig. 2: *Wart* as a reference to a historical tower). Attached markers might help in the disambiguation.

Field names and route names are full of semantics (see Fig. 3 where *Wein Straße*, *Post-Straße*, *alte Straße* all refer to the same route). It can also be observed that *Bircken Schlag* and *Wüstung* (Fig. 3) refer to an area also denoted as *Pecho-fenschlag* (Fig. 4b). Besides textual clues, image processing based on line and shape matching is useful as well.

Figures 1a and 1c show that the track between Tauberbischofsheim and Miltenberg is part of a larger route towards Frankfurt. Such information is important when georeferencing old maps (e.g. Fig. 1b can be identified as part of it). In addition, *Franckfürter Stras* can be detected as a fourth name addressing the old route (Fig. 1d).

Numbered: Boundary stones, wayside shrines, etc. provide important reference points and they might still be present in the terrain. References to boundary stones are often numbered. The same numbers may occur multiple times on a map segment. Stones may have been (re)moved, or the numbering may have changed over time (see Fig. 4). Disambiguation including geospatial and textual clues is necessary here, too.

Marked: Template matches of markers across multiple maps cannot always be assumed. Yet, symbolic representations can be useful (Fig. 5). Singular stones are difficult to georeference. However, shape properties from their connections and relative locations reveal useful information (see e.g. Fig. 3).

Image-content-based: Map entities such as lakes, roads, lots can be georeferenced using matching techniques from image processing relying on color, texture, and shape (see [4], [5]); sometimes in addition to text, numbers, and markers. However, the availability of such gazetteer information is limited. Fig. 3 shows a lot where shape similarity is obvious.

It is our goal to encourage local history researchers who georeference map entities for their research to publicly share this data on OSM and Wikimedia projects such as Commons (see e.g. [6]). OSM can be used to georeference historical routes and related items. Commons is helpful to display photographs with epigraphs and additional metadata. Georeferencing could involve textual resources, too. By linking such data and old maps, this can lead to groundtruth data for new digital map processing algorithms. Finally, it is crucial to validate the results, even if correct from an algorithmic perspective (see Fig. 2). OSM, Commons, etc. allow for a crowdsourcing approach here. In the future, we plan to build a public test collection.

¹e.g.: <http://www.georeferencer.com/> and <http://linkeddata.uni-muenster.de/georeferencer/georef.html> (last visit: 15.3.17)

²e.g.: <http://www.leo-bw.de/kartenbasierte-suche> and <http://kartenforum.slub-dresden.de/> (last visit: 15.3.17)



Fig. 1: The route from Tauberbischofsheim to Miltenberg and Frankfurt. Markers in magenta added for highlighting.

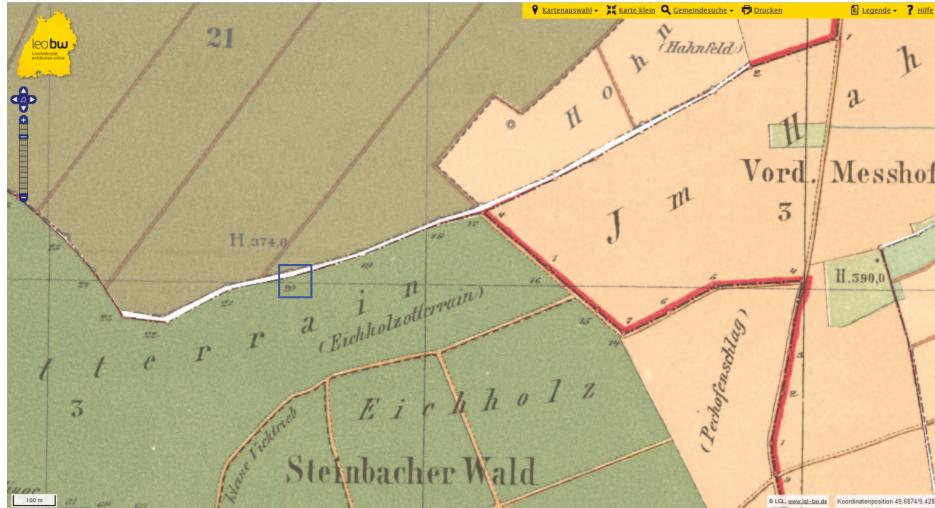


Fig. 2: The map [11] shows a route from top right to lower left: *Bischofsheim - Miltenberg*. It is only a schematic view: the actual route went south of, not north of *Eyersheim* and it went through *Diffenthal*.





(a) Extract of Münzmeister Eberhard's map with the numbering of boundary stones [16].



(b) Ambiguous numbering of stones shown by the Historische Gemarkungspläne (Baden) [17].

Fig. 4: Stones where the numbering has changed. N. 17 (b) corresponds to N. 27 (a). It can thus be deduced that stone N. 20 (b) corresponds to N. 30 (a). Text labels such as *Pechofenschlag* (an alternative name for the parcel shown in Fig. 3) or *Eichholz* can help georeferencing the stones. Stone N. 1 occurs three times on the map (b).

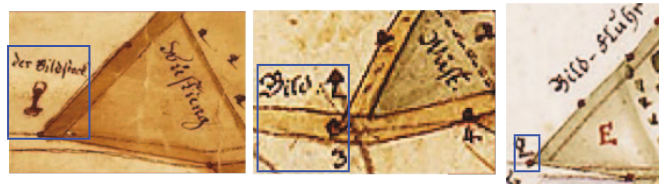


Fig. 5: Wayside shrine: *der Bildstock*, *Bild*, icon on the 3rd map (LTR: [13], [18], [19]). The name of the lot *Bild-Fluhr* addresses the prominence of the stone.

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