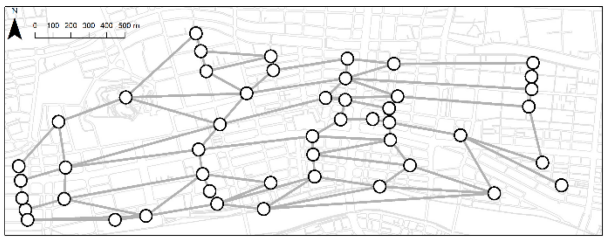


# Graph analysis of an old map of castle towns in early modern Japan

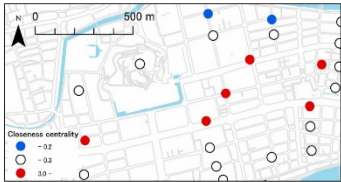
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A classic picture map of *Kochi* castle town drawn in 1841 is analyzed. The ages during which those picture maps were drawn are limited, and it is difficult to know how the forms of the castle towns had evolved and changed only from the maps. In this research, we propose an analytical method of the classic picture maps using GIS for exploring how Japanese castle towns had changed their forms. The method enables us to infer the past process of the changes even from a picture map. This castle town map indicates where a district connects to any other districts. Fo example, we can find *Saiku-cho* connects to the other four districts: *Hasuike-cho*, *Obiya-cho* and *Kon'ya-cho*. Moreover, in case of *Kochi* castle town, we have map-like lists where we can find the names of both residents and districts and their locations.



In the figure (left), the nodes indicates districts of *Kochi* castle town and links indicates connectivity bet-ween the districts. If a link exists between a set of two districts, it indicates the two districts connects directly

each other. We can create this graph from the picture map. For a graph we can calculate measurement indices such as “closeness centrality” and it enables us to consider the formation process of this town.

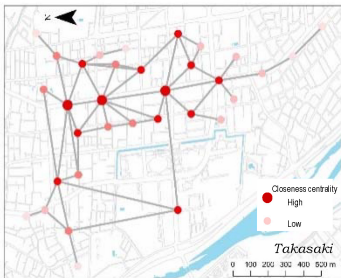


The measurement index,  $C(a)$ , “closeness centrality” of a node,  $a$ , in a graph is calculated as the sum of the topological distance of the shortest paths between the node and all other nodes.

$$C(a) = \frac{\# \text{ of all nodes} - 1}{\sum_i \text{the topological distance from } a \text{ to all other nodes } i}$$

In case of *Takasaki* castle town, where the age of construction of each district can be known from historical documents. When we calculate  $C$  values for each district (left figure) and compare it to the documents, we find the older district has the higher value of centrality.

Based on the case of *Takasaki*, we classify each district of *Kochi* castle town in order of  $C$  values. We find six stages in the forming process (right figures).



Time  
↑  
1841  
Past

The proposed method could help to consider the past forms of Japanese castle towns, where only historical documents have been examined.