

CURVATURE OF MOTOR TRANSPORT SPACE AS A CAUSE AND EFFECT OF ITS TRANSFORMATION

Volodymyr Grytsevych
Ivan Franko National University of Lviv
gvsmsg@ukr.net

In the process of public development and social-economic transformations, there takes place the settling of the territories of human habitation, which manifests itself in the spatial development of transport networks.

In the present research we make an attempt to study the curvature as a metric property of the motor transport space of a particular territory, such as western Ukraine including eight regions, i.e., Volyn, Rivne, Lviv, Ternopil, Khmelnytsky, Transcarpathian, Ivano-Frankivsk, and Chernivtsy.

We define the motor transport space as a part of geospace where trucking takes place. Motor transport space has numerous qualitative and quantitative characteristics that depend on the development and configuration of a particular motor transport network. Transformation of a motor transport space causes the changes of its topological and metric characteristics, such as curvature. On the contrary, comprehension of territorial peculiarities of camber distribution is a starting point in predicting and planning the further transformations. In case a motor transport network undergoes a progressive development, the curvature of its space decreases.

The curvature of motor transport space is defined as a geographical effect which resides in the assumption that the distance between two points defined along the motor transporting roads exceeds the distance between these two points defined along geodetic line.

Curvature ratio is proposed to be introduced for purpose of numerical evaluation of the degree of curvature of motor transport space of a particular territory. Its magnitude depends on a number of factors, as configuration of terrain, the arrangement of big stands and nature-protected sites, economical-geographical location, historical-geographical agent, the available hydronetwork, etc. Let's consider the effect of above mentioned factors on curvature of motor transport space.

Configuration of terrain produces a great effect on the curvature of motor

transport space. Firstly, the development of transport network having a complicated configuration of terrain lags behind the flat territories. Moreover, one should also take into account the difference in altitudes in a mountainous region, which considerably increases the length of the roads being quite straight upon the plan. It is for these reasons that the curvature of transport space increases in mountainous regions.

Continuous big stands of forest, especially in a mountainous area, where an dissection of the terrain is observed, appear to be natural areal barriers for the development of transport networks. Building autoroads through big stands is quite often economically inexpedient. Sometimes, forests are spatially combined with nature-protected and preserved objects, where the road construction is banned.

Among other things, the effect of economical and geographical position manifests itself in the frontier location of the territory in case of international transporting corridors passing here.

Historical and geographical factor is primerily considered from the viewpoint of ekistic preconditions of forming the transport networks, such as interlinking of separate settlements, forming a system of settling, increasing the role of central settlement, construction of magistral hiway.

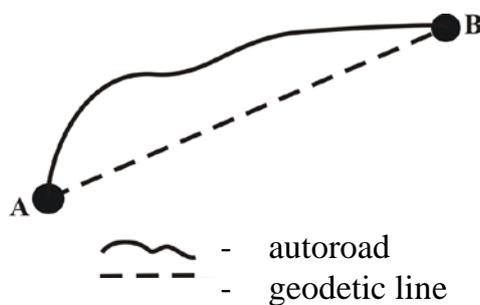


Fig. 1.

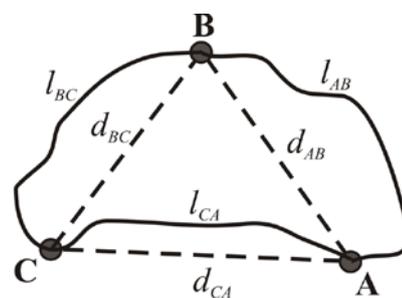


Fig. 2.

Curvature is also effected by the available hydronetset. After all, the bigger is a river the greater transport-barrier effect is produced. Factors that hinder the construction of roads are the necessity to build bridges, fortification structures well as fighting boggy areas in river valleys.

The idea and the techniques of measuring the curvature is as follows (Fig.1). Let us denote the distance of geodetic line between the points A and B by d , and the

length of real autoroad between them by l . Then, we define curvature measure of the space between the points A and B as a relative surplus of l over d expressed in percentage:

$$k = \frac{l-d}{d} \cdot 100\%$$

Thus, if the road between the points runs along the geodetic line, then $k = 0\%$.

In order to cartographically study the curvature of space on the territory of a region, let us lay a specially selected triangulation chart grid over the territory studied, so that triangulation vertices represent the settlements which are motor transport nodes. Let us examine a fragment of a chart grid in Fig.2. Here, A, B, C are nodal points, d_{AB}, d_{BC}, d_{CA} are geodetic distances between the nodes, l_{AB}, l_{BC}, l_{CA} are real lengths between the nodes.

Let us calculate the geodetic D and real L perimeters of the triangle ABC :

$$D = d_{AB} + d_{BC} + d_{CA},$$

$$L = l_{AB} + l_{BC} + l_{CA}$$

In a similar way we determine the curvature ratio of motor transport space upon the triangle studied:

$$k = \frac{L-D}{D} \cdot 100\%.$$

Then, we tie the obtained value to the middle of the ABC triangle.

Having performed this operation all the triangles of the triangulation chart grid, we get a general picture of spatial distribution of the curvature of the motor transport space upon the territory studied. This picture can be interpolated and cartographically depicted using the method of isolines.

For the purpose of a cartographic study of the curvature of space, let us cover the territory of the researched area with a specially selected triangulation grid where the triangulation vertices represent the settlements are motor transporting nodes or road junctions.

In order to quantitatively evaluate the curvature of motor transport space of the Western region of Ukraine, we have constructed a triangulation network that includes

392 triangles. Within each triangle we determined the real motor transport and geodetic perimeters as well as calculated the ratio of curvature.

Distribution of triangles according to the ranges of the curvature logarithm is shown as a diagram in Fig.3 The calculations show that over half of all the triangles are characterized by the curvature of 12,5%-25%, over 27% have the curvature of 25%-50%, 3,6% of the triangles have the curvature of 50%-100%, and only 1% of the triangles have the curvature of over 100%. Sixteen percent of triangulation triangles have the smallest curvature less than 12,5%.

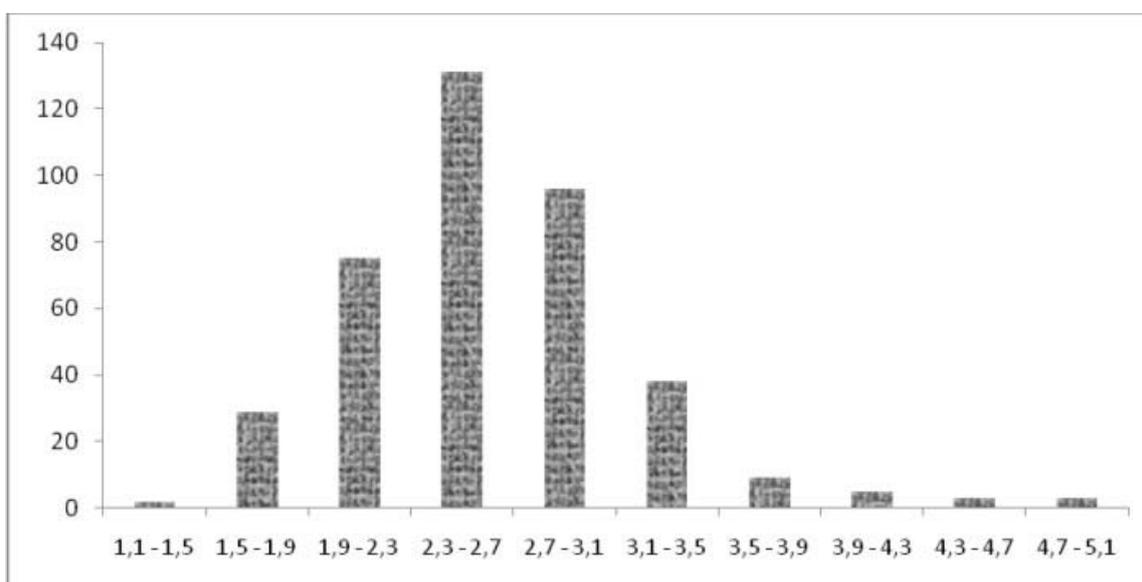


Fig. 3. Distribution of triangles according to the ranges of curvature logarithm.

Let us now perform a geographical analysis of the curvature of real motor transport space of the region. The can observe the maximum values of curvature in high-altitude areas such as Gorgany, Chornohora, Svydovets range, and Gryniava mountains. The highest curvature ratio (over 180%) was noted at the scantily developed area between the nature park “Synevyr” and the natural reserve “Gorgany” where there are no motor roads at all. The territories of the nature protected fund have an elevated curvature of motor transport space. High curvature ratio (over60%) is observed within the Carpathian national nature park and the adjoining territories. The curvature also rises on the territory of the mountain Polonyna Borzhava (Transcarpathian region) as well as in the mountainous frontier part of Turka and Starosambirsky district in Lviv region.

The smallest of curvature is observed within part of the Lviv region, where the motor road network is generally well developed, as well as along the Precarpathian frontal flexure. Here, the development of communication is connected with historical and geographical preconditions caused by the peculiarities of the configuration of terrain, which is comparatively favourable for the development of a network of settlements, including the roads. Curvature of motor transport space is quite low within the flat areas of Volyn region.

Mean values of curvature (30%-60%) are observed along the massif of the eastern Beskyds in Lviv region, as well as in Transcarpathians in the vicinity of the Uzhansky national nature park. The curvature rises in the east of Ivano-Frankivsk region, in the north and north-east of the Chernivtsy region along the powerful Dnister river. Farther on to the north, this stripe of an increasing curvature of motor transport space continues in the eastern part of Lviv region within the low-altitude massifs of Opillia and Gologory.

The territory within the international transporting corridor №5 south of Stryi has the curvature ratio lower than the mean ratio, where, despite a complicated configuration of terrain, there is branched system of roads linked with the arterial road. Low indices of curvature of space are also observed in some parts of Transcarpathian region in particular, to the south of the transport node of Mukatchevo, in the east of Khust and in the south of Tiachiv regions along the national automobile road having numerous branches.

Elevated value of curvature ratio is observed within the Voroniak and Kremenetsky mountains, Mizotsky ridge, Medobory and in the mid Prednistrovia.

A special characterization deserves a suburban area of Lviv, which is the largest city and the most powerful transport node in the region.

We can see that the curvature of motor transport space essentially increases to the north-west of Lviv within the boundaries of physical-and- geographical region of Roztochya having a continuous road network. It is the adjoining territory of the frontier zones of the Yavorivsky national park and of the “Roztochya” reserve that actually hinders the process of building automobile roads. Futhermore, an elevated

curvature in this part of suburban zone is caused by, the unfinished northern section of the ring road.

Curvature of space higher than the average one is observed in the wooded partitioned locality between Bibrka and Mykolaiv within the Opillia massif. High curvature is also typical of the wooded and boggy territories in the valley of the Poltva river in the far west of Pustomity district, where there runs a railway that does not intersect any high-class automobile roads.

On the whole, the curvature ratio of almost half the territory of the suburban zone ranges from 20% to 40%. Separate patches of an increased curvature ratio are observed between Didyliv and Zhovtantsy as well as to the south-east of Pustomity.

Conclusions. Studying the curvature of motor transport space reflects the extent of transport development of a territory and its metric peculiarities. The value of curvature ratio is effected by a number of factors of natural and socio-geographical character. In particular, within the western region of Ukraine we can observe a stronger effect of natural conditions. Trying to consider a separate suburban zone of Lviv we can state that topological characteristics of the transport network are decisive here. A low curvature ratio is typical of the territories of the flat part of the region with a high antropogenic development. The highest values of curvature are observed in mountainous localities – over 30%, while in high-altitude regions it exceeds 180% on separate patches. Localities of elevated curvature are potential territories for the development of a motor transport network taking into consideration socio-economic interests which are the basis for considerable social transformations in the region.

REFERENCES

The development of motor transport space reflects the level of the development and transformation of the territory on the whole. The curvature of space decreases in the process of a progressive development of a transport network. The paper formulates a definition of the notion of curvature of motor transport space. Geographical factors effecting the curvature are described. The possibility to quantitatively measure and cartographically depict the curvature of motor transport space is substantiated. A method is proposed for quantitative evaluation of curvature based on a specially constructed triangulation network. Since the present research has a fundamental character, it is performed upon the real territories, and has already been fulfilled for the territory of western region of Ukraine. Triangulation network has been built for this region, and the curvature ratio has been determined for each triangle. Maps of spatial distribution of the curvature have been made. Space analysis of curvature distribution has been performed. A conclusion has been made stating that territorial distribution of the curvature indicates promising trends in transport transformations.