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CONTEXT / MUNDARIJA

The importance of calibration in modeling vehicle car-following behavior

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Abstract:	Nowadays, one of the important issues is the safe traffic on the roads and their arrival at their destination without delay and spending less time and energy. For this purpose, by simulating traffic movements in computer programs, the necessary changes are made without spending a lot of time and money, getting the results. In this article, we considered the importance of calibrating input data in the simulation of traffic movements. In this process, several literatures on calibration were analyzed, experimental work was conducted, conclusions were drawn based on the results, and tasks to be carried out at the next stage were determined.
Keywords:	modeling, Weidemann 74 model, calibration, safety distance, lead car

Transport oqimini modellashtirishda kalibrovkalashning ahamiyati

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Annotatsiya:	Hozirgi kunda yo'llarda transport vositalarining xavfsiz harakatlanishi va manziliga kechikmasdan kam vaqt va energiya sarflab yetib borishi muhim masalalardan biri hisoblanadi. Buning uchun transport harakatlarini kompyuter dasturlarida simulyatsiya qilish orqali natijalarni olib, ko'p vaqt va mablag' sarflamasdan kerakli o'zgartirishlar amalga oshirilmoqda. Ushbu maqolada transport harakatlarini simulyatsiya qilishda kiritiladigan ma'lumotlarni kalibrovka qilishning ahamiyatini ko'rib chiqdik. Bu jarayonda, kalibrlash bo'yicha bir nechta adabiyotlar tahlil qilindi, sinov tajriba ishlari amalga oshirildi, natijalar bo'yicha xulosa qilindi va keyingi bosqichda amalga oshiriladigan topshiriqlar belgilab olindi.
Kalit so'zlar:	modellashtirish, Vidman 74 modeli, kalibrlash, xavfsizlik masofasi, yetakchi avtomobil

1. Kirish

Transport oqimini boshqarishda alohida transport vositalarining harakatini va ularning o'zaro ta'sirlashuvini o'rganish muhim. Bunda transport oqimini modellashtirish orqali yo'llarda transport harakatini malakali tashkil etishga erishiladi [1].

So'nggi yillarda mikroskopik transport oqimi hisob (simulyator) dasturlari yo'l harakatini tashkil etish muhandislari uchun muhim vositalarga aylandi [2]. Yetakchi (leading) va uni kuzatuvchi (follower) avtomobil orasidagi masofani aniqlash bu dasturlarda asosiy o'rin tutadi [3]. Bu oraliq masofa asosan keng qo'llaniladigan Vidman 74 (Wiedemann 74) modeli orqali ifodalanadi. Bu model parametrlari qiymatlarini tijoriy dasturlarda o'zgarish oraliqlari berib o'tiladi. Lekin haydovchilarning transport vositasini haydash xatti-harakatlari (driver behaviour) turli davlatlarda turlicha bo'lsihi mumkin. Bu o'z navbatida haydovchi parametrlarni kalibrovkalash ahamiyati yuqori ekanligini ko'rsatadi.

2. Metodlar

Yetakchi avtomobil bu oldinda harakatlanuvchi transport vositasi bo'lib u bilan muayyan oraliq masofani saqlab, yetakchini dinamik ko'rastkichlarini takrorlashga harakat qiluvchi avtomobilni - kuzatuvchi (yetaklanuvchi) avtomobil sifatida tavsiflash mumkin [4]. Yetakchi va kuzatuvchi avtomobillarni o'zaro ta'sirlashuvini turli matematik modellari ishlab chiqilgan [4-10]. Bu dasturlarda eng ko'p tarqalgan model Vidman 74 (Wiedemann 74) modeli Rainer Wiedemann tomonidan 1974 yilda taklif etilgan bo'lib [10], VISSIM dasturida turli transport oqimida haydovchilarning xatti-harakatlarini taqlid qilish uchun mo'ljallangan. Bu taqlid asnosida asosan yetakchi va kuzatuvchi avtomobillar oraliq masofasi modellashtirilib, real ma'lumotlarga mos kelishi model aniqligini belgilab beradi.
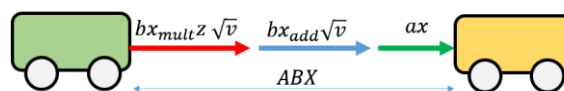
1-rasm. **Vidman 74 modeli [10]**

Adabiyotlarda Vidman 74 modeli quyidagi tarzda berilgan chiziqli tenglama shaklda ifodalanadi [10, 11]:

$$ABX = ax + bx_{add}\sqrt{v} + bx_{mult}z\sqrt{v}$$

Bu yerda:

ABX – oraliq masofa (m);

ax – tinch turgan holdagi oraliq masofa (m);

bx_{add} – qo'shimcha xavsizlik masofasi, (m);

$bx_{mult}z$ – tezlikka bog'liqlik masofasi, (m);

v - sekin harakatlanuvchi transport vositasining tezligi, (m/s).

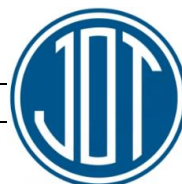Vidman 74 modelida ax, bx_{add} va $bx_{mult}z$ parametrlarini kalibrovkalash (rostlash) kerak.

Kalibrovkalash simulyatsiya qilingan va eksperimental olingan natijalar qiymatlari o'rtasidagi farqni minimallashtiradigan model parametrlari to'plamini topishni o'z ichiga oladi [12].

Yuqorida keltirib o'tilgan parametrlarning oraliq masofaga ta'sirini o'rganish maqsadida, Qarshi shahridagi Islom Karimov va Mustaqillik shox ko'chalari kesishmasidagi aylanasimon harakat tashkil qilingan chorrahaning PTV Vissim dasturida virtual modeli ishlab chiqildi. Natijalarni kalibrovkalashda ax, masofani o'zgarmas deb qabul qilib va bx_{add} va $bx_{mult}z$ qiymatlarini 0.5 dan 5 gacha 0.5 interval bilan o'zgartirildi. Keltirilgan chorrahaning PTV Vissim dasturida hisob natijalari tahllili quyida keltirilgan.

Ushbu chorrahada ikkita kamera o'rnatilib 24 soat davomida videoyozuvlar yozib borildi. Ertalab 8.00 dan 9.00 gacha vaqt oralig'ida chorrahadan o'tgan transport vositalari soni hisoblandi va PTV Vissim dasturida simulyatsiya qilish uchun foydalanildi. Temiryo'l vokzali tomondan Islom Karimov ko'chasidan bir soatda 1228 ta transport vositasi, Yerqo'rg'on bozori tomondan Islom Karimov ko'chasidan bir soatda 1897 ta transport vositasi, Qarshi muhandislik iqtisodiyot instituti tomonidan Mustaqillik shox ko'chasidan bir soatda 1828 ta transport vositasi, Beshkent yo'li tomonidan Mustaqillik shox ko'chasidan bir soatda 2175 ta transport vositasi harakatlangan (2-a rasm). PTV Vissim dasturida Qashqadaryo viloyati Qarshi shahri Islom Karimov va Mustaqillik shoh ko'chalari kesishmasidagi aylanma harakatlanish uchun mo'ljallangan chorrahasi simulyatsiya qilindi (2-b rasm) .

a)

b)
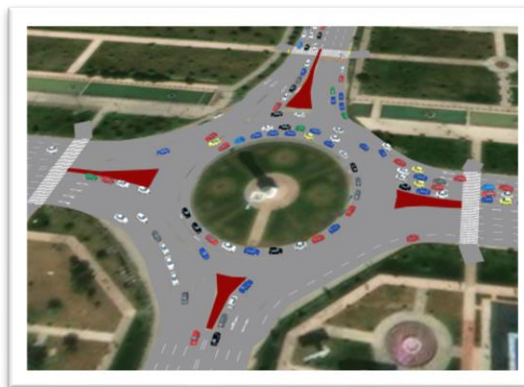
2-rasm. Qarshi shahri Islom Karimov va Mustaqillik shoh ko'chalari kesishmasidagi aylanma harakatlanish uchun mo'ljallangan chorrahasi: a) xaritada ko'rinishi va b) VISSIM dasturi modeli

3. Natija va muhokamalar

Olib borilgan tadqiqotlar natijasida mamlakatimizda yo'lovchi transporti xizmati sifatini belgilovchi 6 ta asosiy va 4 ta zarur hollarda hisobga olinishi mumkin bo'lgan quyidagi parametrlar guruhidan (va parametrlar) iborat bo'lishi lozimligi aniqlandi.

Chorrahaning parametrlari o'rganilib PTV Vissim dasturida simulyatsion model tayyorlanildi va bu dastur yordamida olingan natijalar 1-va 2- jadvallarda keltirilgan. 3-rasmda esa ushbu qiymatlarning grafik ko'rinishi ifodalangan. Bu olingan natijalar tahlilidan keyingi sinov-tajriba ishlarida foydalanish uchun ma'lumot sifatida qo'llanilishi mumkin. Shuningdek, ushbu maqoladagi uslublardan foydalanib boshqa chorraha va yo'l segmentlarini kalibrovkalash va simulyatsiya qilish uchun ham foydalanish mumkin.

1-jadval
Chorrahada sarflangan yonilg'ining bx_{add} va bx_{mult} ko'rsatkichlari ga mos qiymatlari

| bx_{add}/bx_{mult}	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
0.5	494.5	492.3	514.8	473.2	474.8	470.6	467.8	466.7	478.3	497
1	484.4	480.8	462.5	476.4	507.4	499.8	499.6	476.4	478.5	488.8
1.5	467.2	457.9	472.7	470.9	487.7	498.2	506.2	493.7	490.1	494.1
2	487.8	507.9	469.9	482.1	491.2	513.4	516.6	504.2	**513.8**	492.4
2.5	478.1	520.4	400.5	515.2	516.6	505.4	502.6	491.7	520.2	495.1
3	508.8	507	490.7	496.2	507.2	499.6	560.9	514.9	512.8	538.6
3.5	515.1	529	502.4	512.4	530	505	485.1	504.1	527.7	525.2
4	518.4	512	506.3	548.8	561.5	526.6	524.8	522.1	597.4	518
4.5	593.5	548.7	562.5	493.7	609.3	535.9	537.1	552.3	544.4	592.8
5	517	530	532.3	515.8	501.7	569.6	546.4	549	563.5	549.1

2-jadval

Chorraha tirbandligining uzunligini bx_{add} va bx_{mult} ko'rsatkichlari ga mos qiymatlari

bx_{add}/ bx_{mult}	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
0.5	82.89	81.4	87.89	85.11	88.67	87.43	89.4	91.13	91.71	93.33
1	84.7	85.68	85.84	89.42	89.25	89.59	90.61	87.62	91.87	93.65
1.5	86.56	87.27	87.87	89.26	91.63	92.55	92.94	92.15	93.02	93.86
2	89.21	90.24	90.15	89.44	92.14	92.04	90.45	92.2	115.06	93.53
2.5	89.93	91.4	88.07	93.3	94.58	93.75	92.26	95.6	95.77	93.95
3	88.82	92.71	92.17	91.44	95.38	94.88	96.78	96.5	102.26	99.61
3.5	94.27	95.52	93.46	97.08	96.23	97.46	96.96	99.24	99.82	100.27
4	92.72	94.78	95.31	98.58	100.24	99.28	100.73	100.28	103.82	101.62
4.5	97.61	98.14	100.84	98.42	101.06	100.95	101.36	101.92	105.07	105.88
5	96.78	98.74	100.46	102.41	101.31	104.03	101.5	104.82	105.89	105.5

a)
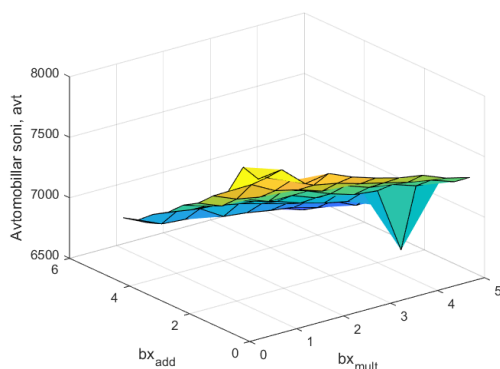
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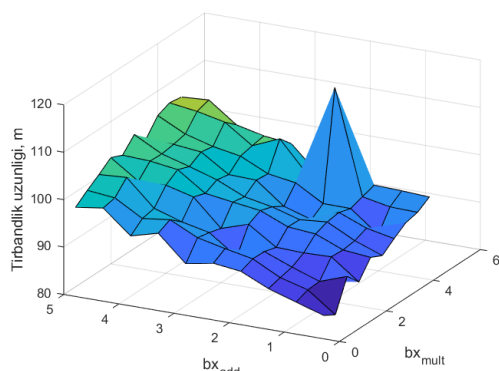
3-rasm. Turli bx_{add} va bx_{mult} qiymarlarida a) chorrahadan o'tayotgan avtomobillar soni va b) ular hosil qilgan tirbandlik uzunligi

Natijalar shuni ko'rsatdiki, bx_{add} va bx_{mult} qiymatlarining oshishi oraliq masofaning oshishiga olib keladi. Bu o'z navbatida transport oqimi miqdorlariga ta'sir qilib, chorrahadan o'tgan avtomonillar sonining kamayishi, hosil bo'lgan tirbandlik uzunligining aksinch o'sishiga olib keladi. Berilgan bx_{add} va bx_{mult} qiymatlari diapazonida chorrahadan o'tuvchi avtomobillar soni 17.5% va tirbandlik uzunligi 25% o'zgarishi aniqlandi. Demak, faqat haydovchining xatti-harakatlari natijaviy qiymatlarga 25% gacha ta'sir qilishi mumkin.

4. Xulosa

Ushbu maqolada chorrahalarni loyihalash uchun simulyatsiya qilish, kalibirovkani imkon qadar aniq qilish va real aniqlangan ko'rsatkichlar bilan uyg'unligi naqadar muhimligini ko'rsatadi. Chorrahani kompyuter dasturlarida simulyatsiya qilib, kerakli o'zgartirishlarni avval boshidan aniqlab olib, keyin amalda qo'llash transport xarajatlarini kamaytirishiga olib keladi. Shuningdek, mavjud transport tarmoqlari samaradorligini oshishiga, atrof-muhitni saqlash va transport foydalanuvchilariga maksimal qulaylik yaratishda yordam bo'ladi. Vidman 74 modelini qo'llash orqali olingan natijalar berilgan bx_{add} va bx_{mult} qiymatlari diapazonida chorrahadan o'tuvchi avtomobillar soni 17.5% va tirbandlik uzunligi 25% o'zgarishi aniqlandi. Demak, faqat haydovchining xatti-harakatlari natijaviy qiymatlarga 25% gacha ta'sir qilishi mumkin va o'z navbatida bu ko'rsatkichlarni to'g'ri kalibrovkalsh zaruriyatini ko'rsatadi.

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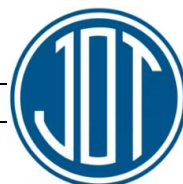
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