SELECTION OF WHEEL CHASSIS FOR MOBILE ROBOTS IN COURSE OF PRODUCTION PROCESSES AUTOMATIZATION

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A***bstract:*** *The article presents the possibility confirmation suitable type of mobile modules (chassis) of mobile robots for the automatization of production processes. From this point of view the paper is specialized on verification behavior same types of wheel chassis at cross different obstacles. Verification is practice in system MSC/ADAMS with optimum variants evaluation. The more detailed attention is devoted to the determination suitable profile tires of wheels chassis for tested obstacles. According to type of surface and cross obstacles we can select suitable variant of wheel chassis for mobile robot or robot with extension.*
Key words: *mobile robot, chassis, extension, transportation, measurement.*

1. INTRODUCTION

The sphere of engineering and non-engineering production bear possibilities for the application of mobile robots on wheel chassis. The mobile robots can have different construction with reference to supply required service tasks, which can link to the production operations performed by industrial robots. Robots move in a different environment with obstacles which must at the realization automatization of production processes cross. The obstacles may have known or stochastic. Therefore it's necessary for given to type of environment suitable elect optimal type of chassis.

2. VERIFICATION BEHAVIOR PROPERTY OF WHEEL CHASSIS IN SYSTEM MSC/ADAMS

At choice of mobile robot for practice service tasks in the realization automatization of production processes it is requirement choose suited type of the chassis [3]. Decisive factor for choice of chassis it's kind of environment and definition possible obstacles. From elect variants of designed 3D model we can verify behavior on the prepared model of polygon. On the basis type environment for which are characteristic definite sorts of obstacles and terrain unevenness they will be follow train resistance. From defined driveway resistances will carry out proposal of driving subsystems of the chassis and will determine wheel diameter and width wheels. After the type environment we can designed kinematics structure chassis with appropriate number and ordering of driving and freely rotating wheels too. The prepared design we can create in CAD/CAM. In this case was used the system Pro/ENGINEER Wildfire [2].

The prepared 3D models we can import to the system MSC/ADAMS and prepare for approach simulation. Subsequently to each model in the system MSC/ADAMS add model of environment (polygon) after which the robot will moved. On model of polygon they are created possible obstacles that may the robot in practice cross. Consequently it is possible by the transaction simulation verify behavior of robot at cross of obstacles. At cross of obstacles can be verified drive in direct direction or after engaged trajectory. We can verify stability of robot at drive after inclined plane too [1].

At verification drive ability property in direct direction it is elect least suitable starting position of robot in face of obstacles on the polygon. Subsequently it is possible verify following parameters, behavior and characteristics of the robot:

- Verification maximum momentum on the motors for driving of wheels and. comparison with computed momentum at crossed obstacles on the polygon.
- Verification of the robot cross maximum high obstacles on which was designed with set of speed, acceleration and momentum of motor.
- Verification even if the robot is able crossed all of inclined planes and asperities of terrain on the polygon.
- Verification deviation the robot from required direction at crossed all sectors on the polygon.
- Verification whether the robot stop to hang on wheel or some parts of the frame on obstacle.
- Use torque control for wheels drives and verification behavior at drive through identical race on the polygon.
- Verification position, speed, acceleration and forces on single parts of chassis.
- Another requirement on verification drives property of the chassis.

Every approach simulation for verification of drive property, behavior and required parameters it is possible save to the independent modulus. Obtained values we can project to the animation, 2D or 3D graphs etc. This way gained results it is possible compare and on the basis of that perform appropriate check on changes of construction chassis. It is suitable compare more designed of variants of the chassis for same type of service task (same the polygon). Pursuant to verification of several models at drive after same trajectory we can choose of optimal variant of kinematics ordering chassis. For presentation of this procedure it is designed simple model of the polygon with obstacles shown on fig. 1 on which will verify driving properties of these type chassis:

- Three-wheel chassis controlled by Ackerman way.
- Four-wheel chassis with more degree of freedom.
- Four-wheel chassis with differential control way.

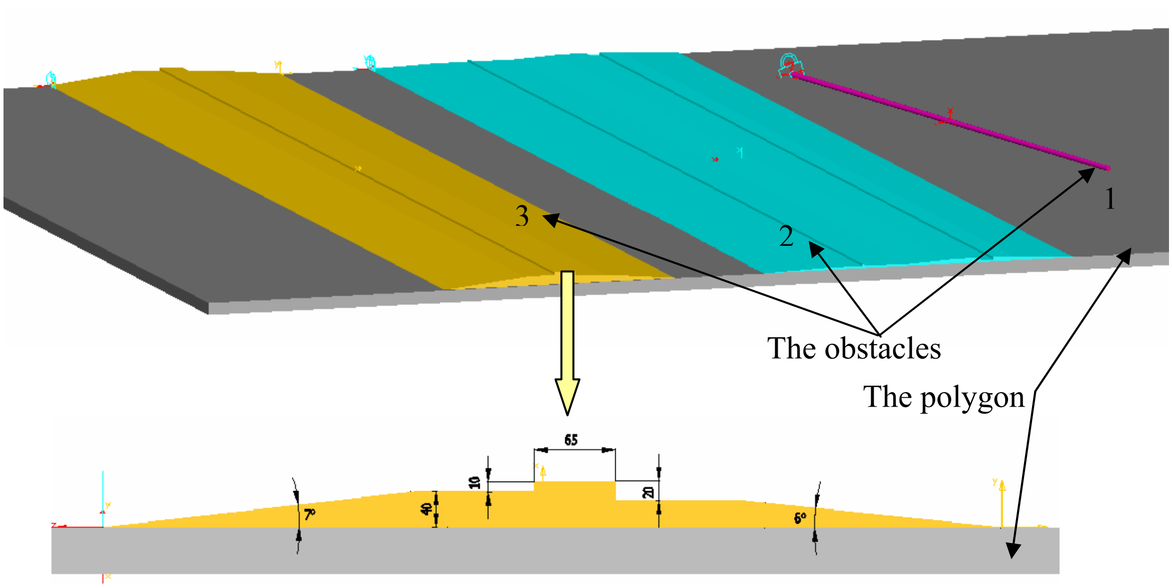


Fig.1 The m*odel of polygon for testing chassis*

First was tested of the three-wheel chassis controlled by Ackerman way. The model of this chassis with marked line on polygon is shown on fig. 2a. On fig. 2b is shown the graph deviation position centre of gravity of the chassis in axis z and deviation longitudinal axis from straight direction. At crossed obstacles there attends to local deviation of chassis from defined straight line. At end position after traveling trajectory it is possible determine final deviation position of select point (centre of gravity chassis) in axis z (Δz) including orientation longitudinal axis of chassis (angle which clasp longitudinal axis with straight line required course of movement).

For interpretation deviations position centre of gravity of the chassis in axis x, y, z and changes orientation longitudinal axis we can select suitable speed range of movement with appropriate step. For simple demonstration were select only three speeds (v=0,3 m/s, v=0,5 m/s, v=0,7 m/s). From here graph follows, that expansion speed of movement at crossed obstacles it is at the end of traveling line position deviation bigger. The same simulation were performed for tire with semicircular cross - section

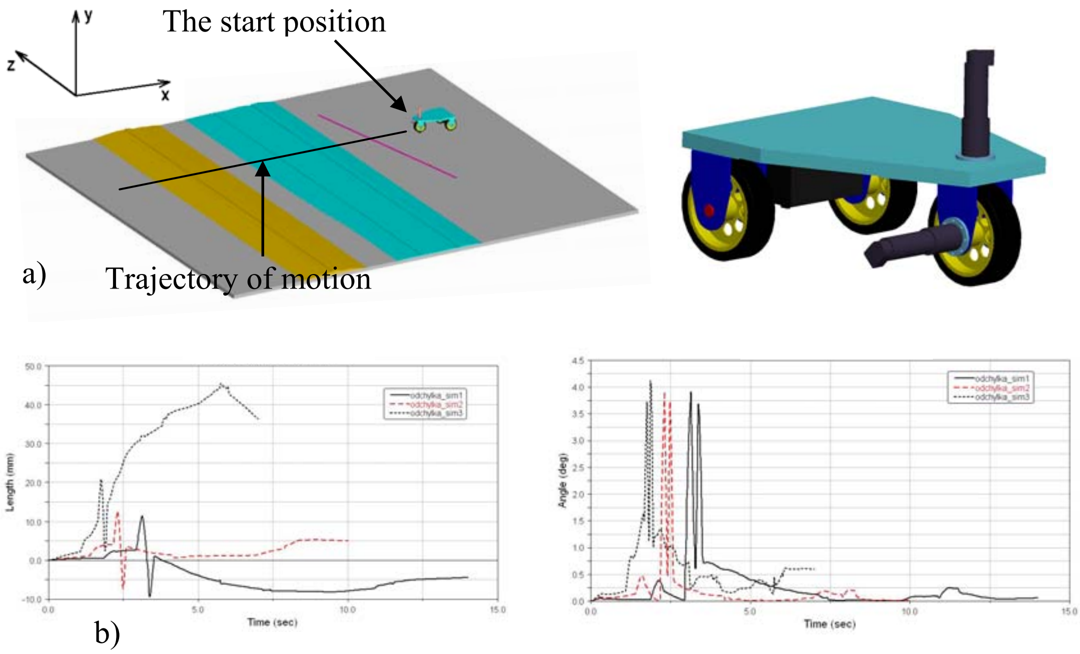


Fig.2 *The model of chassis controlled by Ackerman way and graph with result of simulation*

As a second was tested four-wheel chassis with more degree of freedom. The model of this chassis is shown on fig. 3a. For possibility of verification it has chassis approximately same basic dimensions as a three-wheel variant. The smallest deviation was realized at speed v=0,5 m/s. During crossed obstacles the deviations of position hold just about same values. The angles deviation turning of longitudinal axis in end position is increase more as compared to previous of the three-wheel variant chassis.

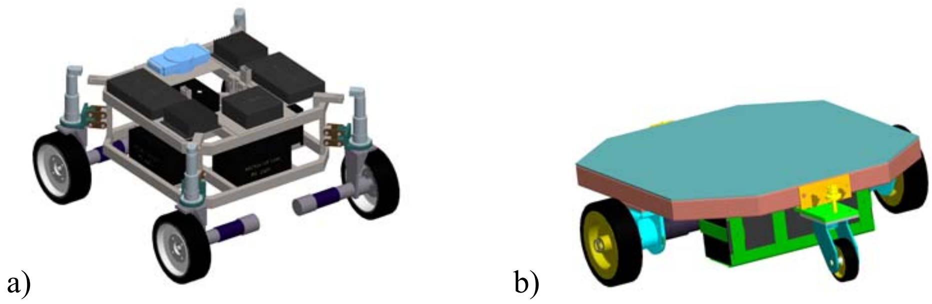
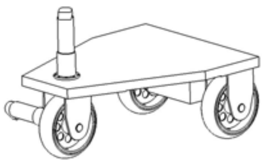
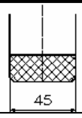
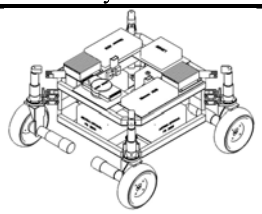
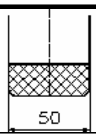
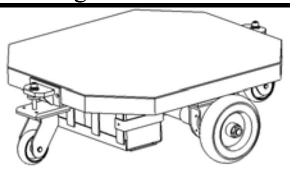
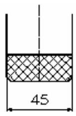


Fig.3 *The model of four-wheel chassis with more degree of freedom a) and Four-wheel chassis with differential control way b)*

As a third was tested four-wheel chassis with differential way control. The model of these chassis is shown on fig. 3b. For possibility of verification it has chassis approximately same basic dimensions as previous variants. This type of chassis it is possible crossed obstacle with high 20 mm, but essentially will change driving direction. It is due to smaller average of supporting wheels (Ø 160 mm). At improvement of driving property on the obstacles with high 20 mm would had to have supporting wheels the same average as a driving. At the speed v=0,3 m/s essentially will change driving direction already on the other obstacle. In the table 1 there are presented results of simulations for all of three type chassis and both type of the tire.

Table 1. results of simulations for three types of the chassis tested

Type of the chassis	**Type of the tire**	**Deviation position centre of gravity chassis in end position [mm]**			**Angular deviation longitudinal axis of chassis in end position angle [deg]**		
		Speed of movement chassis [m/s]			**Speed of movement chassis [m/s]**		
		0,3	**0,5**	**0,7**	**0,3**	**0,5**	**0,7**
 Three-wheel chassis controlled by Ackerman way		-0,45	5,0	36,0	0,15	0,03	0,75
		20,35	10,05	40,0	0,2	0,15	0,55
 Four-wheel chassis with more degree of freedom		5,1	3,2	6,0	0,1	0,1	0,15
		-4,2	-4,5	-0,8	0,1	0,1	0,1
 Four-wheel chassis with differential control way		2050	1500	250	-78	-43	-45

From results of simulation follows that the speed v=0,5 m/s as optimal at crossed obstacles. In this case is concerned evaluation always only of the three executes simulation for given to type of tire. For specify of valuation obtained results it is necessity carry out bigger number of simulation and bigger range at speeds of movement. Obtained values from performed analysis it is necessary verify on produce prototype of the chassis too

3. APPLICATION OF EXTENSION ON THE CHASSIS

For some application at the automatization of production processes we can use different types of extension. This extension we can fasten on the chassis. There is in this case the extension for obtaining 3D metrical data. Therefore depends in this case on optimal option of the chassis regarding to accuracy obtained dates. The model of extension in 3D is shown on fig. 4.

Fig.4 *Designed mobile robot construction*

In the event designed extension not once about manipulation with subjects nor about practice technological operation. Extension is determinate only for carried of cameras system and illuminative body. Two cameras are determinate for acquisition of couple pictures measurement object. Third camera, take surrounding environment of robot and make possible navigation his movement to the required direction. Condition for making couple of pictures and their processing is horizontal position of both cameras and parallelism axis of both objectives. Therefore must be top platform extension always before making of pictures for measurement adjusted to the horizontal position independently of position chassis. The horizontal position of top platform extension supervision climb indicator.

4. CONCLUSION

The obtained values from executed analysis it is need verify on manufactured prototype of the chassis too. This article was compiled as part of projects GACR 105/03/0719, 2003 too.

5. REFERENCES

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