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BENCHMARKING ANALYSIS OF THE APPLICATION OF SMALL BEARING REDUCERS AND ACTUATORS IN SERVICE ROBOTICS.

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Abstract: The article analyzes the current state of deployment of various types of reducers and actuators used in mobile service and personal robots. It focuses on the search trends of the possible application of small bearing reducers and actuators in the robot.

INTRODUCTION

Small bearing reducers are suitable for use in mobile service robot arms, while their advantage is high transmitted torque, high accuracy and rigidity. Their deployment has resulted in an increase in total tonnage of robot arms in compliance with any resulting increase in accuracy. Deployment actuators over a separate small focal reducer further simplifies the design and management of the main arm movement for better mutual compatibility of the drive as a whole. The principal disadvantage of the deployment of small bearing reducers and actuators is now possible to consider their high price, because their deployment is successfully applied only in those cases where it is in terms of accuracy, rigidity where appropriate by torques is their deployment preferably, or necessary.

1. PARAMETERS OF SMALL BEARING REDUCERS AND ACTUATORS

Small bearing reducer (SBR) TWINSPIN TS-50 Fig. 1 (c. Spinea Prešov, a.s.) is intended primarily for use in working arm knots of service robots, for shooting the cameras and other visual techniques on mobile robot chassis.

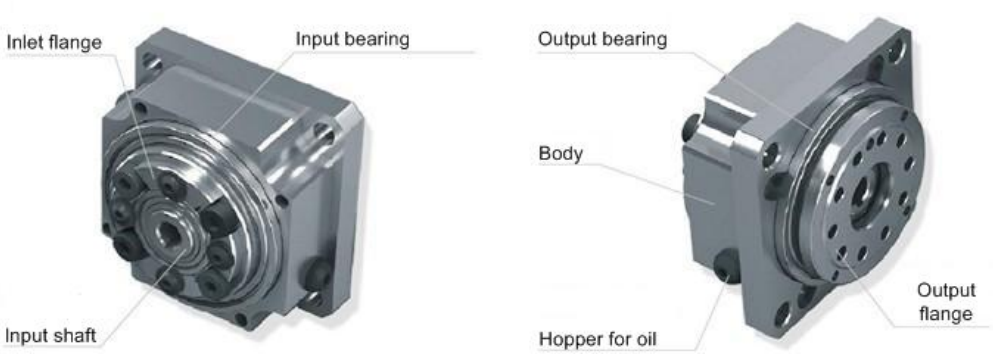

Figure 1. TS 50 reducer essential parts

It is characterized by small (compact) size, high accuracy and repeatability, ease of installation and the ability to dial the release of various types, such as: output shaft pass, through hole (hollow shaft), increased accuracy, increased resistance to temperature and similarly.

The basic parameters and characteristics of reducer TS-50 are:

- ratio: i=63, rated output torque Tr = 18 Nm, rated speed nr = 2000 ot/min,
- acceleration / braking torque Tmax = 36 Nm, weight m = 0,47 kg,

- maximum speed nmax = 5000 ot/min, moment of inertia T = 0,007.10-4 kgm2.

Actuator DriveSpin DS 50, Fig.2 (c. Spinea Prešov, a.s.) is designed so as reducer TS - 50 for deployment in the working arm nodes of service robots, for shooting the cameras on mobile robots and similarly.

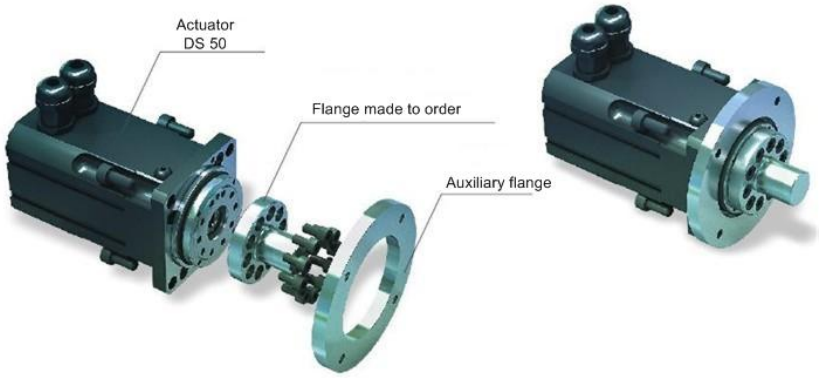

Figure 2. Actuator DS 50 with attachment

Actuator DS 50 is also characterized by relatively small size, high accuracy and repeatability, ease of installation and the ability to dial the different types of versions, where possible, adapting to customer requirements not only in terms of their properties, but also the supply of well-defined elements of a case with additional devices. The basic parameters and characteristics of the actuator DS 50 (ratio, rated torque, speed) are consistent with reducer TS 50.

2. ANALYSIS OF CURRENT STATE OF BEARING REDUCTORS AND ACTUATORS USE IN ROBOTIC DEVICES

Analysis of global reports about current applications of robotic devices (robots) confirms that in addition to keeping pace in the "classic" applications of robots for the manufacturing industry (engineering) processes, significant expansion was recorded in the robot applications so-called non-industrial, and non-productive areas.

In parallel with ongoing development and implementation of robot characters and traditional characteristics (industrial robots), in stage of dynamic development of the new category of intelligent robots that are designed for completely new operationally applications and for the economically new user interface.

One of these new categories is the category of intelligent application-specific robots, the category of service robots (SR).The emergence of this new category of robots rise and determined to require non-industrial practice to formulate requirements for their functional features and characteristics arising from their destination for technology and new technical roles in service activities, as well as the requirements of their intended for industrial applications and new operational environment. Under the term service activities we can to understand non-productive activities (services, other activities) which contribute to the manufacturing of goods, but are useful for human or technical and operating systems. Studies of the OSN and IFR Economic Commission testify that from 2006 to 2009 has increased the use of service robots about 2.19 million new installations (start-up status in 2003 was 625 440 units), of which was 2.16 million units installed in the space of private (personal) use. On Fig. 3 is a graph showing the service robots used in the professional sphere to the year 2007, and in the years 2007 to 2010, according to IFR.

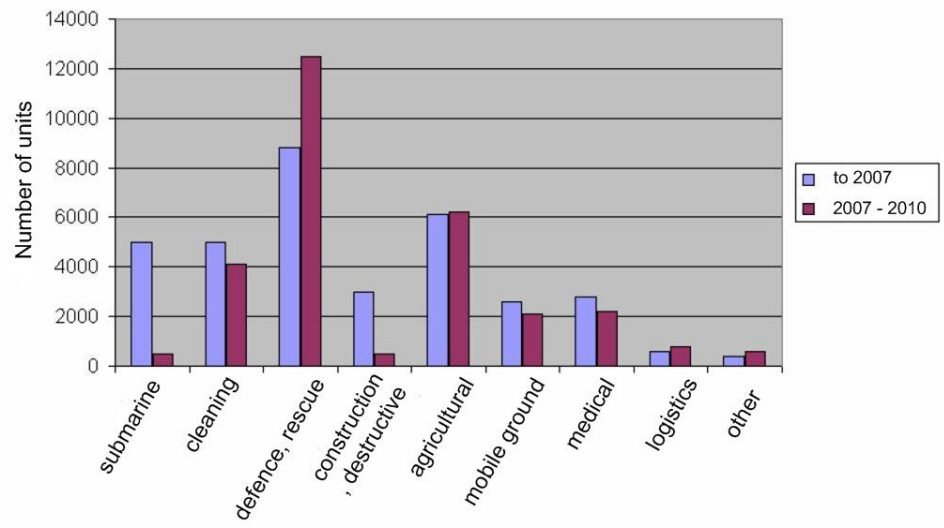

Figure 3. Deployment of service robots in various industries

Previous deployment of bearing reducers or actuators in robotic fields should apply mainly in the construction of industrial robot arm with a medium or higher load capacity, due to their greater weight and large dimensions. Building smaller and lighter types (small bearing reducers), allowing their use in areas of service robotics, by rotating the camera systems, dealing with knots of handling extensions and drive wheeled robots or crawler robots.

3. DRAFT GUIDELINES FOR ASSESSMENT OF SMALL BEARING REDUCTORS (SBR) AND ACTUATORS FOR THE FIELD OF SERVICE ROBOTICS

To carry out this analysis was proposed methodology, which focuses primarily on analyzing the potential of setting SBRs and actuators in service robotics given to existing solutions, as well as to define spaces, and the reasons why other principles are successful on market.

Industry area	Types of equipment	Analysis		Potential application in device types / number *		Nodes			Application potential according to the size	
		number of companies	number of devices			Analyzed	Potential use	ks	BR	A
Service robotics	Service robots in industry	47	55	robots for inspection services and	18	98	1 axis of extension	25	** 50–56 % 70–34 % 110–10 % 140–0 % ***	50–56 % 70–34 % 110–10 % 140–0 %
							2 axis of extension	21		
				robots used in energetics	17		3 axis of extension	16		
				robots in manufacturing processes	14		Drive of mobile platform	28		
	Personal robots	15	18	robots for household and cleaning	9	24	Drive of mobile platform	16	50–49 % 70–38 % 110–13 % 140–0 %	50–49 % 70–38 % 110–13 % 140–0 %
				walking robots	9		Power of the Executive Body	4		

Explanation: BR – bearing reductor, A – actuator

*- are given only the most numerous types of service robots in use,

**-„50“ size council of bearing reducer (average body BR or A in [mm]),

*** -„0%“- possible expression of the potential deployment of BR or A in [%].

Figure 4. Table of analyzed service robots types

Based on this methodology have been developed tables shown in Fig. 4. The table on Fig. 5 shows an example of a typical representative of a service robot equipped with handling extension. The table has shown the location of suitable nodes and their parameters. The next part of the table has shown the applicable Size Board of bearing reducers (actuators) and potential producers of similar equipment.

The result of analysis is the state in which we express percentage " the possible application potential" of individual size of bearing reducers or actuators in different types of service and personal robots, Fig. 5. Analysis was performed on a sample of 62 companies engaged in manufacturing various types of service and personal robots.

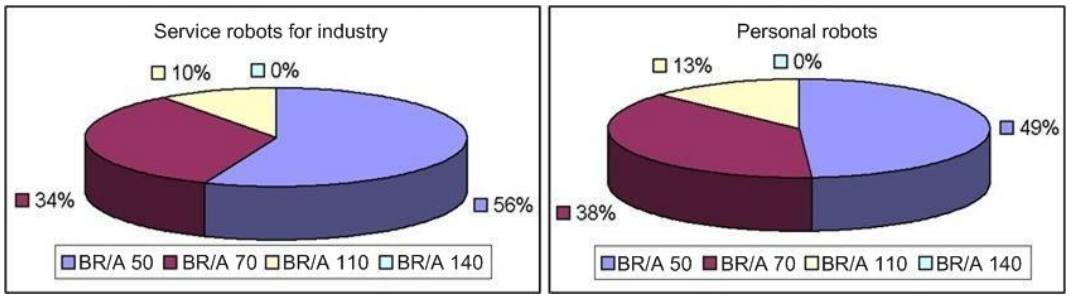

Figure 5. The potential of BR and A use in service and personal robots

4. CONCLUSION

The aim of benchmarking analysis is to quantify the deployment potential of small bearing reducers and actuators in the fields of service robotics and to determine the direction of its further development. Using the results of benchmarking analysis is possible to determine trends of development for the next period and effectively modernize product base for sophisticated products with high added value. Potential Manufacturer's gain from benchmarking and marketing professionally sound basis for decisions about the types of products, segments applications and from the field of precision mechanical and mechatronic drive systems suitable for deployment in service robots.

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4. Websites and catalogs of service and personal robots producers.

Contribution was based on the project: „Research and development of a new board of bearing reducers for low torque and precision actuators and drives, and mobile manipulation platforms“, Activity No. 6, challenge code (KaHR-13SP- 08001).