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# DESIGN SERVICE ROBOT BODY FOR HANDLING

**ABSTRACT:**
*The paper deals approaches to design service robot body for handling. The advantage of using robots handling tooling service is the integration of service activities and manipulation activities, which can perform such a conception. Part of the article is also a procedure for the preliminary draft skeletal units. A prerequisite for building such systems is a deeper revision of existing design methodologies and their closer links with systematized accumulated knowledge base in the discipline.*

**KEYWORDS:**
*service robot body, handling, CAD Design*

## INTRODUCTION

*Current trends in the development of robotic equipment links is to the autonomy of these systems. Such a system must have the characteristics of artificial intelligence. Basic concepts of industrial robots, manufactured in the world, reached a high technical level and reliability and are able to cooperate with other production and auxiliary systems in the fields of engineering and non-engineering applications. Variety of service activities in service robotics need to use different principles for solving various tasks, mainly handling [1].*

*Handling body integrates a buffer and transport handling. Thus integrating the two elements we can achieve high efficiency and flexibility for single and series production.*

## DESIGN PROCESS OF HANDLING EXTENSIONS

*Basic assumptions for the design construction is to determine which kinematical chains such as cut-off parameters perform the handling tasks in terms of geometry - then it is possible to find a clear solution in terms of handling the structural requirements. The next step we determine the kinematical characteristics of at least approximately in the sense that we try to minimize the number of options for minimizing the transfer time, or to minimizing the speed and acceleration. Such an investigation will show trends, but not a clear solution. Based on the range of characteristics is necessary to determine the final concept prototype, taking into account the dynamic characteristics (Figure 1).*

*After the draft concept of the superstructure of the type series, devise modules according to the concept of solutions. Using system profiles there is a building superstructure to the desired shape. Following this is followed by a preliminary calculation, specifying the dimensional characteristics of the individual and the ballast element. For each element, it is necessary to bring the energy distribution (electric power, power. Signal, ...), which will allow us to interconnect these devices.*

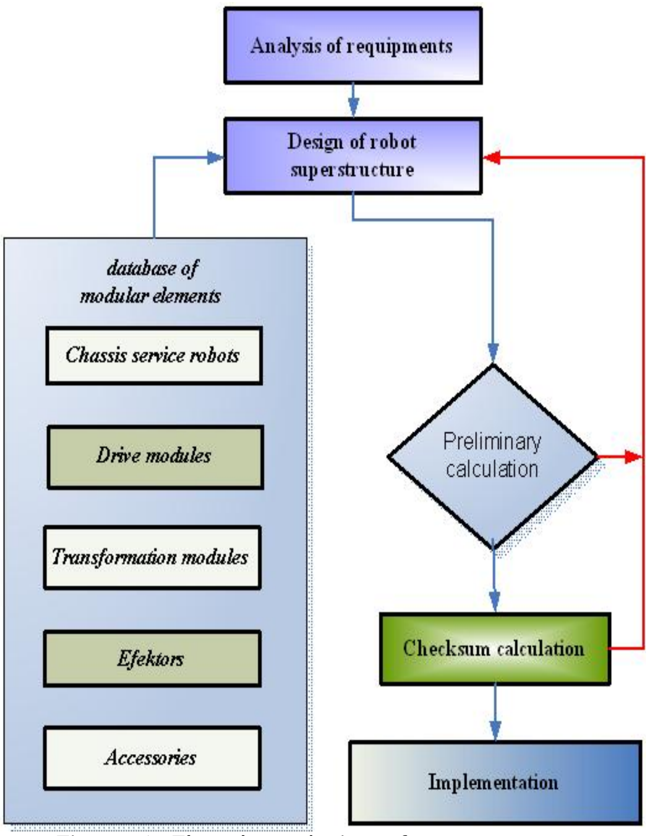


*Figure 1. Flowchart design of superstructure*

*If necessary, use different types of sensors results in their installations. After creating the following proposed superstructure is necessary to transfer control and carry out the conversion of mutual distance, the geometric dimensions given the assignment requirements (internal dimensions, throughput, max landing, ...). When checking (testing) there is a fine-tuning the relative positions of the superstructure and fixed. In case of unsatisfactory results, it is necessary to revise any of the various parts of the superstructure or change the concept of solutions. If the extension meets the required parameters, it is possible to make control design solutions with routes of energy security.*

*The preliminary draft is to be combined with computer-aided tools [5] preliminary calculations and estimates to refine ideas based on the chosen design parameters (kinematic scheme aa major nodes or sets). These are mainly estimates of kinematic parameters and the required engine power and the choice of the optimum gear ratio. Next, it estimates power ratios, accuracy and stiffness of individual kinetic units. It draws upon earlier experiences and results of verification of their own structures from the analysis of competing products.*

## CALCULATION OF THE PARAMETERS ROTARY AND TRANSLATION DRIVE UNIT

*After estimating the basic dimensions of kinematics scheme and range of motion before the start of cross-sectional design and shape of pieces of physical units is necessary to establish preliminary performance engines and choose a particular manufacturer and dimensional types [2]. Engines, respectively drives constitute a significant burden on the effects of their materials. In doing so, however, their determination takes place at a time when we do not have enough data for their proposal - it is not known and the distribution of body size and other elements of units.*

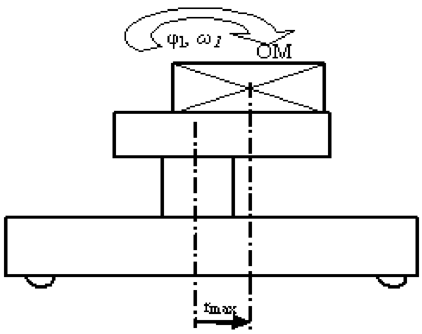


*Figure 2. Input values for the design of rotary unit*

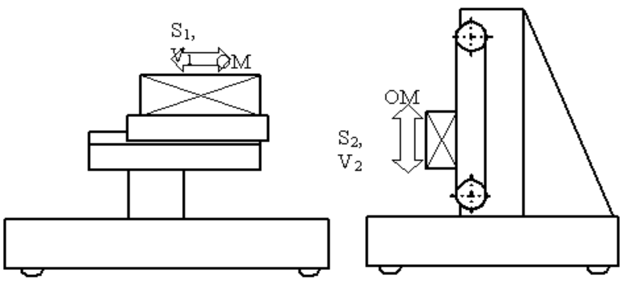


*Figure 3. Input values for the design of translation unit*

*In Figure 2 and Figure 3 are indicated by the input parameters, of them based on estimates of other values of calculation parameters of the drive.*

*Legend:*

*m - weight [kg]*

*r - max. radius [m]*

*$\varphi_1$, $s_1$, $s_2$,- max. transfer object manipulation (OM) [rad, m]*

*$\omega_1$, $v_1$, $v_2$ - nominal transfer speed of the OM [$s^{-1}$, $ms^{-1}$]*

*To determine the rotational power unit will be based on the known (1):*

$$P_r = \frac{(M_n + M_d)}{\eta} \cdot \omega \qquad (1)$$

*$\eta$ - transfer efficiency between the engine and modulators*

*$M_n$ - moment of unbalanced masses, including OM relative to the axis of rotation*

*$M_d$ - dynamic torque at start-up, reflect only the cost of some simplification*

*Assume a trapezoidal velocity profile, Figure 4.*

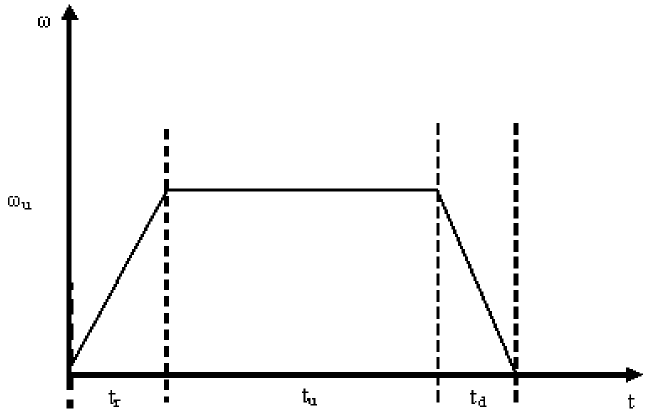


*Figure 4. Trapezoidal velocity profile, length start $\varphi_r = k_1 . \varphi$; length end $\varphi_h = k_1 . \varphi$*

*The value of $k_1$ can be determined from the consideration that for given $\omega$ (or in) as the speed of the transfer facility will be handling the transfer time is shorter (ie higher speed design features), where $k_1$ is smaller, but the result will be more dynamic loads on mechanical power and lower life structural elements, problems with management (with vibration) and possibly extend the period of relocation (if it is necessary to wait for the vibration). It is optimizing the role.*

*Consider the normative dynamic loads and accelerations in [$ms^{-1}$] at similar manipulators and the same class as the calculation of 1.5 a.*

*For a linear actuator with values normally obtained with stroke = 1m and speed v = 1 ms-1 is then possible to track the acceleration estimate (2).*

$$s_r = \frac{1}{2} a t_r^2 , \qquad t_r = \frac{v}{a}$$

$$s_r = \left(\frac{a}{2}\right)\left(\frac{v}{a}\right)^2 = \frac{v^2}{2a} = \frac{1^2}{2.2{,}5} = 0{,}2[m] \qquad (2)$$

*Taking as an example a = 2.5 [ms-1], then it is possible to estimate:*

$$k_1 = \frac{S_r}{S} = \frac{0{,}2}{1} = 0{,}2 \qquad (3)$$


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*Engine power for rotary units we can calculate (4)*

$$\varphi_r = \frac{\varepsilon}{2} t_r^2 = \frac{\varepsilon}{2}\left(\frac{\omega}{\varepsilon}\right)^2 ; \quad \varepsilon = \frac{\omega^2}{2\varphi_r} = \frac{\omega^2}{2k_1\varphi} ; \quad t_r = \frac{\omega}{\varepsilon} \qquad (4)$$

*To estimate the moment of inertia of masses moving units (5)*

$$I = I_r + I_M = k_2 I_r ; \quad I_r = m_{(M)} r^2 \qquad (5)$$

*$I_M$ - moment of inertia of the rotating parts manipulator at. $r_{max}$,*
*$k_2$ - rate design structure, obtained by a similar type of analysis module.*
*For example $k_2$ = 1,8 - 2,3 (6)*

$$M_d = I.\varepsilon = k_2 I_r \frac{\omega^2}{2k_1\varphi} = k_2 m_{(M)} r^2 \frac{\omega^2}{2k_1\varphi}$$

$$M_n = k_3 m_{(M)} g r \cos\alpha \qquad (6)$$

*and $k_3$ we find again transferred from the earlier structures, expresses the dependence of the total unbalanced moment to load manipulator.(7)*

$$k_3 = \frac{M_n}{m_{(M)} g r} \qquad (7)$$

*To estimate power of rotation for moving units around a horizontal axis [4]. (8)*

$$P_r = \frac{(M_n + M_d)}{\eta} \cdot \omega =$$
$$= \left( k_3 m_{(M)} g r \cos\alpha + k_2 m_{(M)} r^2 \frac{\omega^2}{2k_1\varphi} \right) \frac{\omega}{\eta} = \qquad (8)$$
$$= \frac{\omega r m_{(M)}}{\eta} \left( k_3 g \cos\alpha + \frac{k_2 r \omega^2}{2k_1\varphi} \right)$$

*For rotation around the vertical (z axis) does not work to drive them mass (Mn). (9)*

$$P_{r(z)} = \frac{m_{(M)} r^2 \omega^3}{\eta\varphi} \left( \frac{k_2}{2k_1} \right) =$$
$$= \frac{m_{(M)} r^2 \omega^3}{\eta\varphi} \left( \frac{2}{2.0.1} \right) = 10 \frac{m_{(M)} r^2 \omega^3}{\eta\varphi} \qquad (9)$$

## CONCLUSION

*The importance lies in developing solutions and integrated solutions to improve handling equipment and systems. Prerequisite for building such systems is further reprocessing of the existing design methodologies and their closer links with systematized accumulated knowledge base in the discipline [3].*

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