CLAIMS

1. A method for controlling and regulating motors MOT_m of a robot, with m = 1, 2, ...M, wherein
   - the robot has robot components that are interconnected via a number N of articulated connections GEL_n, with n = 1, 2, ..., N;
   - joint angles of the articulated connections GEL_n can be adjusted by means of associated motors MOT_m;
   - $Z(t_k) = \{z_p(t_k)\}$ is a state of the robot components in an interval t_k, wherein k = 0, 1, 2, 3, ... and p = 1, 2, ..., P;
   - a first system of coupled motion equations BG_G is predetermined and describes rigid-body dynamics or flexible-body dynamics of the connected robot components;
   - in the first system of motion equations BG_G, $u_m(t_k)$ is a manipulated variable for the respective motor MOT_m, and
   - for the first system of coupled motion equations BG_G, restrictions of the manipulated variables $u_m(t_k)$ and restrictions of the states $Z(t_k)$ of the connected robot components are predetermined, comprising the following steps:

1.1 for the first system of coupled motion equations BG_G, providing (101) a second system of locally equivalent decoupled motion equations BG_E that describes the rigid-body dynamics or the flexible-body dynamics of the connected robot components;

1.2 providing (102) restrictions of the manipulated variables $u_m(t_k)$ transformed into the second system and providing restrictions of the states $Z(t_k)$ transformed into the second system;

1.3 providing (103) the state $Z(t_k)$ transformed into the second system as $Z^*(t_k)$;

1.4 for the second system of decoupled motion equations BG_E, setting (104) a target state SZ* of the robot manipulator which is to be reached starting from the state $Z^*(t_k)$ takes place, and setting (104) one or more conditions BD* and/or one or more characteristics KZ* that define how to achieve the target state SZ*,

1.5 in the second system of decoupled motion equations BG_E, predicting (105) a

state trajectory ZT*(t) and the associated manipulated variable trajectories $uT^*_m(t)$ depending on the state $Z^*(t_k)$ and the target state SZ* while meeting the conditions BD*, the characteristics KZ*, the transformed restrictions of the manipulated variables $u_m(t_k)$, and the transformed restrictions of the states $Z(t_k)$ for an interval of $t = t_k$ to $t = t_{k+w}$, wherein $\Delta t = t_{k+w} - t_k$ is a predetermined prediction interval;

1.6 transforming (106) the manipulated variable trajectories $uT^*_m(t)$ and the state trajectories ZT*(t) into the first system of coupled motion equations BG_G to generate manipulated variable trajectories $uT_m^{**}(t)$ and state trajectories ZT**(t);

1.7 from the manipulated variable trajectories $uT_m^{**}(t)$ determining (107) of manipulated variables $u_m(t_{k+1})$ for the next interval k+1 and regulating the motors MOT_m by means of the manipulated variables $u_m(t_{k+1})$;

1.8 from the state trajectories ZT**(t) and/or on the basis of sensor data of a detection system of the state Z(t), determining (108) of the state $Z(t_{k+1})$ takes place for the interval k+1; and

1.9 for $Z(t_k) = Z(t_{k+1})$, performing the method again, starting with step 1.3, until a predetermined break-off criterion or the target state SZ* is reached.

2. The method for controlling and regulating motors MOT_m of a robot, with m = 1, 2, ...M, wherein

- the robot has robot components that are interconnected via a number N of articulated connections GEL_n, with n = 1, 2, ..., N;
- joint angles of the articulated connections GEL_n can be adjusted by means of associated motors MOT_m;
- $Z(t_k) = \{z_p(t_k)\}$ is a state of the robot components in an interval t_k, wherein k = 0, 1, 2, 3, ... and p = 1, 2, ..., P;
- a first system of coupled motion equations BG_G is predetermined and describes rigid-body dynamics or flexible-body dynamics of the connected robot components;
- in the first system of motion equations BG_G, $u_m(t_k)$ is a manipulated variable for the respective motor MOT_m, and
- for the first system of coupled motion equations BG_G, restrictions of the

manipulated variables $u_m(t_k)$ and restrictions of the states $Z(t_k)$ of the connected robot components are predetermined, comprising the following steps

2.1 for the first system of coupled motion equations BG_G, providing (101) a second system of locally equivalent decoupled motion equations BG_E that describes the rigid-body dynamics or the flexible-body dynamics of the connected robot components, and a regulating and/or control law RG for the manipulated variables $u_m(t_k)$;

2.2 providing (102) restrictions of the manipulated variables $u_m(t_k)$ transformed into the second system, restrictions of the states $Z(t_k)$ transformed into the second system, and a regulating and/or control law RG transformed into the second system as RG*;

2.3 providing the state $Z(t_k)$ transformed into the second system as $Z^*(t_k)$;

2.4 for the second system of decoupled motion equations BG_E, setting one or more conditions BD* and/or one or more characteristics KZ* that define the framework in which the regulating and/or control law RG should be applied,

2.5 in the second system of decoupled motion equations BG_E predicting (105) a state trajectory ZT*(t) and the associated manipulated variable trajectories $uT^*_m(t)$ are predicted depending on the state $Z^*(t_k)$ and on the basis of the regulating and/or control law RG transformed into the second system while meeting the transformed restrictions of the manipulated variables $u_m(t_k)$, and the transformed restrictions of the states $Z(t_k)$ are predicted with at least an accuracy of < 20 % for an interval of $t = t_k$ to $t = t_{k+w}$, wherein $\Delta t = t_{k+w} - t_k$, wherein $W > k$ is a predetermined prediction interval;

2.6 transforming (106) the manipulated variable trajectories $uT^*_m(t)$ and the state trajectories ZT*(t) into the first system of coupled motion equations BG_G to generate manipulated variable trajectories uTm**(t) and state trajectories ZT**(t);

2.7 from the manipulated variable trajectories $uT_m^{**}(t)$ determining (107) manipulated variables $u_m(t_{k+1})$ for the next interval k+1 and regulating the motors MOT_m by means of the manipulated variables $u_m(t_{k+1})$;

2.8 from the state trajectories ZT**(t) and/or on the basis of sensor data of a detection system of the state Z(t), determining (108) the state $Z(t_{k+1})$ for the

interval k+1; and

2.9 for $Z(t_k) = Z(t_{k+1})$, performing the method again, starting with step 2.3, until a predetermined break-off criterion is reached.

3. The method according to claim 1 or 2,
wherein: N = M and n = m.

4. The method according to claim 1,
wherein the target state SZ* is predetermined in a time-variable manner: SZ* = SZ*(t).

5. The method according to claim 4,
wherein the target state SZ*(t) is determined depending upon obstacles in the surroundings of the robot which are recognized by a surroundings sensor system.

6. The method according to one of claims 1, 4 or 5,
wherein a condition BD* is that the target state SZ* is reached in minimal time, and/or that the target state SZ* is reached with a minimal energy requirement of the motors MOT_m, and/or that the target state SZ* is reached with a minimal braking distance of the joint angles of the articulated connections GEL_n, and/or that the target state SZ* is reached with a minimal braking distance of all the connected robot components.

7. The method according to one of claims 1 or 4 to 6,
wherein an initial state $Z(t_k)$ is a rest state of all robot components, in which a joint angular speed of all articulated connections GEL_n is equal to zero, the target state SZ* is a predetermined motion state of the robot components, and the target state SZ* should be reached in a minimal time.

8. The method according to one of claims 1 or 4 to 6,
wherein an initial state $Z(t_k)$ is a motion state of the connected robot components, the target state SZ* is a rest state of all robot components in

which a joint angular speed of all articulated connections GEL_n is equal to zero, and the target state SZ* should be reached in a minimal time.

9. The method according to one of claims 1 to 8,
wherein in the first system of coupled motion equations BG_G a space spanned by motor torques of the motors MOT_m is described by a hypersquare Ω, of which the transformation into the second system of decoupled motion equations BG_E produces a hypersquare, wherein in the second system based upon the hypersquare Ω_V a greatest possible hypersquare Ω_V' is determined, for which it is the case that a back transformation of the hypersquare Ω_V' into the first system is located completely inside the borders of the hypersquare Ω, and wherein the determination of the manipulated variables $u_i^*(t)$ takes place only on the hypersquare Ω_V'.

10. A device for controlling and regulating motors MOT_m of a robot, with m = 1, 2, ...M according to a method according claims 1 or 4 to 9, wherein
- the robot has robot components that are interconnected via a number N of articulated connections GEL_n, with n = 1, 2, ..., N;
- joint angles of the articulated connections GEL_n can be adjusted by means of associated motors MOT_m;
- $Z(t_k) = \{z_p(t_k)\}$ is a state of the robot components in an interval t_k, wherein k = 0, 1, 2, 3, ... and p = 1, 2, ..., P;
- a first system of coupled motion equations BG_G is predetermined and describes a rigid-body system or flexible-body system of the connected robot components,
- in the first system of motion equations BG_G, $u_m(t_k)$ is a manipulated variable for the respective motor MOT_m, and
- for the first system of coupled motion equations BG_G, restrictions of the manipulated variables $u_m(t_k)$ and restrictions of the states $Z(t_k)$ of the connected robot components are predetermined, comprising:

10.1. a means (201) by which, for the first system of coupled motion equations BG_G, a second system of locally equivalent decoupled motion equations BG_E is provided that describes the rigid-body dynamics or the flexible-body

dynamics of the connected robot components;

10.2 a means (202) by which restrictions of the manipulated variables $u_m(t_k)$ transformed into the second system and restrictions of the states $Z(t_k)$ transformed into the second system are provided;

10.3 a means (203) by which the state $Z(t_k)$ transformed into the second system as $Z^*(t_k)$ is provided;

10.4 a means (204) by which, for the second system of decoupled motion equations BG_E, setting of the target state SZ* of the robot manipulator which is to be reached starting from the state $Z^*(t_k)$ takes place, and setting of one or more conditions BD* and/or one or more characteristics KZ* that define how to achieve the target state SZ* takes place;

10.5 a means (205) by which, in the second system of decoupled motion equations BG_E a state trajectory ZT*(t) and the associated manipulated variable trajectories $uT^*_m(t)$ are predicted depending on the state $Z^*(t_k)$ and the target state SZ* while meeting the conditions BD*, the characteristics KZ*, the transformed restrictions of the manipulated variables $u_m(t_k)$, and the transformed restrictions of the states $Z(t_k)$ for an interval of $t = t_k$ to $t = t_{k+w}$, wherein $\Delta t = t_{k+w} - t_k$ is a predetermined prediction interval;

10.6 a means (206) by which transforming of the manipulated variable trajectories $uT^*_m(t)$ and the state trajectories ZT*(t) into the first system of coupled motion equations BG_G takes place to generate manipulated variable trajectories $uT_m^{**}(t)$ and state trajectories ZT**(t);

10.7 a means (207) by which, from the manipulated variable trajectories $uT_m^{**}(t)$, manipulated variables $u_m(t_{k+1})$ are determined for the next interval k+1 and the motors MOT_m are regulated by means of the manipulated variables $u_m(t_{k+1})$,

10.8 a means (208) by which, from the state trajectories ZT**(t) and/or on the basis of sensor data of a detection system of the state Z(t), determining of the state $Z(t_{k+1})$ takes place for the interval k+1; and

10.9 a means (209) which is connected to the means (203) and passes a $Z(t_k)$ to the means (203), for which $Z(t_k) = Z(t_{k+1})$ applies until a predetermined break-off criterion or the target state SZ* is reached.