Claims

1. A manipulator with multi-load adaptive gravity compensation method, characterized in that, comprising the following steps,

S1.1, building a kinematics model for a manipulator;

S1.2, reconstructing a gravity item of a dynamics model;

S1.3, sampling in a no-load static position;

S1.4, sampling in a static position after tools are installed;

S1.5, calculating the value of a parameter to be calibrated of each tool respectively;

S1.6, calculating the mass and the centroid of each tool respectively;

S2.1, calculating a force which is applied to a flange by the tool which is currently installed;

S2.2, compensating for the gravity of the tool.

characterized in that, in step S1.1, a standard D-H method is used to construct a joint coordinate system of the manipulator;

wherein in step S1.2, for the manipulator of the static state, the gravity item G is equal to the joint moment of the manipulator, the gravity item G being related to joint angle θ_i, mass m_i and center of mass c_i;

in step S1.3,under no-load conditions, the manipulator runs to any non-singular position in the workspace, samples joint position and torque readings;

in step S1.4, each tool is installed at the end of the manipulator, and step S1.3 is repeated to perform static position sampling;

in step S1.4, for each tool, after the tool is installed at the end of the manipulator, determine the current effective workspace of the manipulator corresponding to the tool according to the size of the tool, and then repeat step S1.3 for static location sampling of the tool based on the effective workspace;

in step S1.5, the sampling data obtained in step S1.3 and S1.4 are grouped according to tools, and are sequentially substituted into the gravity item in step S1.2; and

in step S1.6, for each tool, the parameter value of calibration when carrying the tool is compared with the parameter value of no-load calibration, and according to the comparison result and the parameter value of the mass, the centroid of the tool, the mass of the end arm in the manipulator, and the centroid of the end arm, to calculate the mass and the centroid of the tool.

2. A multi-load adaptive gravity compensation device for a manipulator, characterized in that, the device comprises:

Model building module, configured to build the kinematics model of manipulator;

Gravity reconstruction module, configured to reconstruct the gravity item of the dynamic model;

Position sampling module, configured to no-load static position sampling;

Position sampling module, also configured to carry out static position sampling respectively after installing each tool;

Parameter calibration module, configured to calculate the parameter value to be calibrated of each tool respectively;

Mass parameter calculation module, configured to calculate the mass and the centroid of each tool respectively;

External force calculation module, is configured to calculate the force that the tool of current installation applies to flange;

Gravity compensation module, configured to compensate for the gravity of the tool;

characterized in that, in the process of building the kinematics model of the manipulator, the model building module uses the standard D-H method to build the manipulator joint coordinate system;wherein the gravity reconstruction module, for the manipulator of the static state, the gravity item G is equal to the joint moment of the manipulator, the gravity item G being related to joint angle θ_i, mass m_i and center of mass c_i;

when the manipulator has no load, the position sampling module controls the manipulator to run to any non-singular position in the workspace, and samples the joint position and torque readings;

after each tool is installed at the end of the manipulator, the position sampling module determines the effective workspace of the manipulator currently corresponding to the tool for each tool according to the size of the tool, then based on the effective workspace, the manipulator is repeatedly controlled to run to any non-singular position in the corresponding effective

workspace, and the joint position and torque readings are sampled;the parameter calibration module groups the sampling data obtained by the position sampling module according to the tool, and successively substituted into the gravity item obtained by the gravity reconstruction module for calculation, to obtain the parameter values to be calibrated for each tool;and

in the process of calculating the mass and centroid of each tool, the mass parameter calculation module compares the parameter values calibrated when the tool is carried with the parameter values calibrated without load for each tool, and compares the results according to the comparison results and the mass of the tool, the relationship between the mass of the tool, the centroid of the tool, the mass of the end arm in the manipulator and the centroid of the end arm, to calculate the mass and centroid of the tool.