

● **actuation method, hardware control labels**

label	contents
$a_1$	pneumatic
$a_2$	hydraulic
$a_3$	motor
$a_4$	electro + hydraulic
$a_5$	pneumatic + motor
$a_6$	cable driven

● **hardware control labels**

label	contents
$bc_1$	remote + operator
$bc_2$	automatic
$bc_3$	human-robot + collaboration
$bc_4$	manual

● **application labels**

label	contents	label	contents	label	contents
$A_1$	road construction	$A_{22}$	masonry construction	$A_{43}$	joint filling
$A_2$	tiling placing	$A_{23}$	on-site rescue	$A_{44}$	panel installation
$A_3$	building service	$A_{24}$	machinery path management	$A_{45}$	cleaning
$A_4$	ferromagnetic surface construction	$A_{25}$	grasp soft objects	$A_{46}$	machinery mapping
$A_5$	earthmoving construction	$A_{26}$	remote operating machines	$A_{47}$	mining
$A_6$	building inspection	$A_{27}$	airforce construction	$A_{48}$	logistics
$A_7$	excavation	$A_{28}$	ceiling construction	$A_{49}$	transmission tower construction
$A_8$	steel construction	$A_{29}$	material, sorting, delivery, distribution	$A_{50}$	operation simulation
$A_9$	tunnel construction	$A_{30}$	Mars/Lunar construction	$A_{51}$	pose estimation
$A_{10}$	glass installation	$A_{31}$	slab finishing	$A_{52}$	measurement
$A_{11}$	wall construction	$A_{32}$	machinery navigation	$A_{53}$	highway construction
$A_{12}$	bridge construction	$A_{33}$	reduce lifting workload	$A_{54}$	arc welding
$A_{13}$	construction monitoring	$A_{34}$	components assemble	$A_{55}$	underwater work
$A_{14}$	equipment positioning	$A_{35}$	construction activity evaluation	$A_{56}$	remote construction
$A_{15}$	building quality assessment	$A_{36}$	diagnosis detection	$A_{57}$	improve home living environment
$A_{16}$	concrete printing	$A_{37}$	timer construction	$A_{58}$	finishing
$A_{17}$	high rise building construction	$A_{38}$	marking	$A_{59}$	object recognition
$A_{18}$	large-scale building construction	$A_{39}$	hazard detection	$A_{60}$	drilling
$A_{19}$	building maintenance	$A_{40}$	harbour construction	$A_{61}$	scaffolding work
$A_{20}$	spraying	$A_{41}$	waste collection	$A_{62}$	fire curtain testing
$A_{21}$	pipe construction	$A_{42}$	disaster restoration	$A_{63}$	contour crafting

## ● control algorithm labels

label	contents	label	contents
<i>ca</i> <sub>1</sub>	SFT algorithm, NNG algorithm	<i>ca</i> <sub>61</sub>	pixels regression
<i>ca</i> <sub>2</sub>	kinematic	<i>ca</i> <sub>62</sub>	image processing
<i>ca</i> <sub>3</sub>	analytical model	<i>ca</i> <sub>63</sub>	Actuator-level languages
<i>ca</i> <sub>4</sub>	estimate ego-position	<i>ca</i> <sub>64</sub>	iterative algorithms + regression model
<i>ca</i> <sub>5</sub>	PI controller + active control algorithm	<i>ca</i> <sub>65</sub>	path-planning
<i>ca</i> <sub>6</sub>	pure-pursuit method	<i>ca</i> <sub>66</sub>	geodetical method
<i>ca</i> <sub>7</sub>	Dijkstra's algorithm	<i>ca</i> <sub>67</sub>	Kalman Filter Algorithm
<i>ca</i> <sub>8</sub>	tractive thrust	<i>ca</i> <sub>68</sub>	Msc. Adams and Matlab/Simulink programs
<i>ca</i> <sub>9</sub>	performance test, evaluation	<i>ca</i> <sub>69</sub>	dynamic model
<i>ca</i> <sub>10</sub>	heuristic	<i>ca</i> <sub>70</sub>	PTP control
<i>ca</i> <sub>11</sub>	Mesh Mould	<i>ca</i> <sub>71</sub>	TCP control
<i>ca</i> <sub>12</sub>	linear interpolation algorithm-TP language	<i>ca</i> <sub>72</sub>	Particle Swarm Optimization (PSO) algorithms
<i>ca</i> <sub>13</sub>	NDT-method	<i>ca</i> <sub>74</sub>	RFID
<i>ca</i> <sub>14</sub>	control travel speed	<i>ca</i> <sub>75</sub>	IFC + BIM
<i>ca</i> <sub>15</sub>	off-line teaching system	<i>ca</i> <sub>76</sub>	LPA* algorithm
<i>ca</i> <sub>16</sub>	user datagram protocol (UDP)	<i>ca</i> <sub>77</sub>	digital signal processing (DSP) controller
<i>ca</i> <sub>17</sub>	admittance control	<i>ca</i> <sub>78</sub>	torque measure methods
<i>ca</i> <sub>18</sub>	CAN-communication	<i>ca</i> <sub>79</sub>	RBF-PID Control
<i>ca</i> <sub>19</sub>	simplified error analysis model	<i>ca</i> <sub>80</sub>	augmented reality techniques (AR)
<i>ca</i> <sub>20</sub>	vision based gesture estimation, CARLoS Scenario	<i>ca</i> <sub>81</sub>	predictive force method
<i>ca</i> <sub>21</sub>	optimizing welding sequence	<i>ca</i> <sub>82</sub>	Generalized Resolution Correlative Scan Matching (GRCSM)
<i>ca</i> <sub>22</sub>	BIM+ Augmented Reality+Human-Machine Interfaces (IMUs)	<i>ca</i> <sub>83</sub>	finite element method
<i>ca</i> <sub>23</sub>	power line communication net	<i>ca</i> <sub>84</sub>	Force feedback control
<i>ca</i> <sub>24</sub>	beacon-based localization method	<i>ca</i> <sub>85</sub>	iterative learning control + fuzzy logic controller
<i>ca</i> <sub>25</sub>	search algorithm	<i>ca</i> <sub>86</sub>	master-slave system
<i>ca</i> <sub>26</sub>	fusion fuzzy, fuzzy logic, fuzzy set theory	<i>ca</i> <sub>87</sub>	Bug-based algorithm
<i>ca</i> <sub>27</sub>	distributed feedback mechanism	<i>ca</i> <sub>88</sub>	"point-to-angle" algorithms
<i>ca</i> <sub>28</sub>	motion simulation	<i>ca</i> <sub>89</sub>	trajectory generation algorithm
<i>ca</i> <sub>29</sub>	planning stigmergy + Linux-based computer	<i>ca</i> <sub>90</sub>	C++, Java, C# script, C program
<i>ca</i> <sub>30</sub>	encoder failure detection algorithm	<i>ca</i> <sub>91</sub>	pre-acting control algorithm
<i>ca</i> <sub>31</sub>	wireless communication, wireless Lan	<i>ca</i> <sub>92</sub>	Virtual Reality
<i>ca</i> <sub>32</sub>	parametric-integrated algorithm, parametric synthesis	<i>ca</i> <sub>93</sub>	bar penetration technique, in-process reinforcing technique
<i>ca</i> <sub>33</sub>	Brooks' algorithm	<i>ca</i> <sub>94</sub>	Raspberry Pi
<i>ca</i> <sub>34</sub>	Anderson Passive control theory	<i>ca</i> <sub>95</sub>	PLC
<i>ca</i> <sub>35</sub>	BIM, prepare the trajectories	<i>ca</i> <sub>96</sub>	real time navigation
<i>ca</i> <sub>36</sub>	PID position control	<i>ca</i> <sub>97</sub>	cost optimization
<i>ca</i> <sub>37</sub>	intelligent beacon	<i>ca</i> <sub>98</sub>	tree-Based algorithm
<i>ca</i> <sub>38</sub>	least squares algorithm	<i>ca</i> <sub>99</sub>	dedicated smart sensors
<i>ca</i> <sub>39</sub>	voltage response	<i>ca</i> <sub>100</sub>	markov chains

<i>ca</i> <sub>40</sub>	collision avoidance algorithms, feed forward control algorithms	<i>ca</i> <sub>101</sub>	robust algorithm
<i>ca</i> <sub>41</sub>	timing algorithm	<i>ca</i> <sub>102</sub>	MPEG algorithm + pair-wise alignment algorithm + Minimum V variance Matching (MVM) Algorithm
<i>ca</i> <sub>42</sub>	HyperCard program	<i>ca</i> <sub>103</sub>	motion planning
<i>ca</i> <sub>43</sub>	inverse kinematic and dynamic models	<i>ca</i> <sub>104</sub>	integral monitoring system
<i>ca</i> <sub>44</sub>	3D printer control	<i>ca</i> <sub>105</sub>	A* algorithm, A-star
<i>ca</i> <sub>45</sub>	discrete event simulation model	<i>ca</i> <sub>106</sub>	point cloud data control
<i>ca</i> <sub>46</sub>	embedded, embedding, controller	<i>ca</i> <sub>107</sub>	random walk algorithm
<i>ca</i> <sub>47</sub>	UML state charts and capsules	<i>ca</i> <sub>108</sub>	positioning system
<i>ca</i> <sub>48</sub>	Hierarchical planning	<i>ca</i> <sub>109</sub>	stereovision method
<i>ca</i> <sub>49</sub>	genetic algorithms (GA)	<i>ca</i> <sub>110</sub>	Iterative Closest Point (ICP) algorithm
<i>ca</i> <sub>50</sub>	kinematic connection	<i>ca</i> <sub>111</sub>	measures vector value of vertical lifting
<i>ca</i> <sub>51</sub>	Iterative Inverse Perspective Matching algorithm	<i>ca</i> <sub>112</sub>	Ubiquitous Sensor Network
<i>ca</i> <sub>52</sub>	longest common subsequence (LCS)	<i>ca</i> <sub>113</sub>	velocity control
<i>ca</i> <sub>53</sub>	forward and inverse geometric model	<i>ca</i> <sub>114</sub>	behaviour-based system
<i>ca</i> <sub>54</sub>	inverse position equation	<i>ca</i> <sub>115</sub>	self-positioning algorithm
<i>ca</i> <sub>55</sub>	teaching robots' specific skills	<i>ca</i> <sub>116</sub>	segmentation approach
<i>ca</i> <sub>56</sub>	best-fit algorithms	<i>ca</i> <sub>117</sub>	automatic battery replacement
<i>ca</i> <sub>57</sub>	C-K Theory	<i>ca</i> <sub>118</sub>	SLAM
<i>ca</i> <sub>58</sub>	soft additive fabrication	<i>ca</i> <sub>119</sub>	error modification
<i>ca</i> <sub>59</sub>	primitive static states	<i>ca</i> <sub>120</sub>	distance estimation
<i>ca</i> <sub>60</sub>	workflow method		
<i>ca</i> <sub>73</sub>	Machine Learning: neural, deep learning, CNN, Computer vision, Deep Reinforcement learning, FCN, neural network, deep convolutional neural networks, RRT algorithm, LNSNet network, Network, Fast R-CNN, BP network, Stacked Hourglass Networks, CV algorithm. open CV.		

## ● sensory system labels

label	contents	label	contents
<i>s</i> <sub>1</sub>	laser + ultrasonic + CCD camera	<i>s</i> <sub>80</sub>	infrared + camera
<i>s</i> <sub>2</sub>	camera + pressure sensor + force sensor + magnetostriction sensor + tactile sensor, gyro	<i>s</i> <sub>81</sub>	angle sensor
<i>s</i> <sub>3</sub>	position sensor + camera	<i>s</i> <sub>82</sub>	laser + lidar
<i>s</i> <sub>4</sub>	image sonars + camera + LBL, gyro	<i>s</i> <sub>83</sub>	IMU + laser
<i>s</i> <sub>5</sub>	pressure sensor + tactile sensor	<i>s</i> <sub>84</sub>	GPS + lidar + camera + angle sensors + distance sensors + force sensor + depth sensor + radar, ultrasonic sensors + IMU
<i>s</i> <sub>6</sub>	torque/force sensor + force sensor	<i>s</i> <sub>85</sub>	pressure sensor + speed sensor + proximity sensors
<i>s</i> <sub>7</sub>	camera	<i>s</i> <sub>86</sub>	range sensor + displacement sensor + GPS
<i>s</i> <sub>8</sub>	pressure sensor	<i>s</i> <sub>87</sub>	range sensors + distance sensor
<i>s</i> <sub>9</sub>	visual sensor	<i>s</i> <sub>88</sub>	pressure sensors + laser sensor
<i>s</i> <sub>10</sub>	ultrasonic	<i>s</i> <sub>89</sub>	liquid based sensor
<i>s</i> <sub>11</sub>	visual sensor + touch sensor + optical detector + arc weaving sensor	<i>s</i> <sub>90</sub>	IR sensor + F/T sensor + acceleration sensor
<i>s</i> <sub>12</sub>	tactile sensing system + welding sensor	<i>s</i> <sub>91</sub>	elasto-magnetic (E/M) sensor

$s_{13}$	arc sensor + laser	$s_{92}$	robust sensor + pressure sensors + force sensors
$s_{14}$	laser	$s_{93}$	LPG sensor + a smoke sensor
$s_{15}$	laser + torch sensor	$s_{94}$	LTK + GPS + pseudofiles + laser + NLS
$s_{16}$	CCD camera + stereo sensor	$s_{95}$	sonar system
$s_{17}$	LIDAR sensors + IMU + Kinetic	$s_{96}$	camera + accelerometers
$s_{18}$	various sensors + sensor system	$s_{97}$	front rear sensors + wireless camera
$s_{19}$	3D laser + camera + torch sensor + galvanometer scanner	$s_{98}$	analogy voltage sensor + laser profile probe
$s_{20}$	vacuum sensor + air pressure sensor + position sensor + camera	$s_{99}$	orientation and proximity sensors + CCD camera + thermographic sensors
$s_{21}$	distance sensor + tilt sensor	$s_{100}$	ultrasonic sensor + Infrared sensor + dangerous gas sensor + noise sensor + light sensor
$s_{22}$	position sensor	$s_{101}$	lidar + IMU
$s_{23}$	rotation angles sensors + vacuum sensors + accelerometers + pressure sensor	$s_{102}$	ultrasonic + Infrared + laser
$s_{24}$	light sensor + infrared proximity sensors	$s_{103}$	camera + laser scanners + inclinometer
$s_{25}$	infrared distance sensors + camera	$s_{104}$	gyro sensor + laser sensor + CCD camera
$s_{26}$	shock sensor + infrared ray sensor + laser sensor, magnetic sensor	$s_{105}$	DSLR camera + rotating sensor
$s_{27}$	laser radar + GPS + RFID	$s_{106}$	camera + force + laser
$s_{28}$	alignment sensor + brake check sensor + obstacle detecting sensors + laser sensors + ultrasonic sensor + HMR sensor	$s_{107}$	radar + acoustic sensors + electrical resistivity sensors + impact-echo + ultrasonic + cameras
$s_{29}$	camera + laser + lidar	$s_{108}$	camera + LED + light
$s_{30}$	GPS + generic pose sensor	$s_{109}$	GPS + camera
$s_{31}$	tactile senses + force sensor	$s_{110}$	pressure sensor + Rotary encoder + potentiometer
$s_{32}$	camera + GPS + dust meter	$s_{111}$	camera + force + laser + pressure
$s_{33}$	force sensor + ultrasonic sensor	$s_{112}$	vision sensor + proximity sensor + peripheral sensors
$s_{34}$	force sensor + sonar sensor	$s_{113}$	rotation angle + encoder sensor + laser, accelerometer
$s_{35}$	vision sensor	$s_{114}$	ultrasonic sensors + encoders + IMU + yaw angle sensor + sonar sensors
$s_{36}$	optical sensors + touch sensor	$s_{115}$	proximity sensor
$s_{37}$	ultrasonic sensor + 2D LIDAR	$s_{116}$	IMU + force sensor
$s_{38}$	cameras + pressure force sensor	$s_{117}$	camera + encoder + proximity
$s_{39}$	camera + image + CCD + Kinect	$s_{118}$	camera + sonar sensor + temperature sensor + airflow sensors + laser
$s_{40}$	position sensor + velocity sensor	$s_{119}$	optical (IR) sensor
$s_{41}$	position sensor + load sensor	$s_{120}$	pressure sensor + tensioner sensor + magnetostrictive sensor
$s_{42}$	rotation sensor + force sensor	$s_{121}$	meteor-sensors + proximity sensor + navigation sensor
$s_{43}$	joint sensor	$s_{122}$	power/torque sensor
$s_{44}$	force sensor + pressure transducers	$s_{123}$	force/ touch sensor
$s_{45}$	force and position sensors + ground penetrating radar (GPR) + laser	$s_{124}$	photoelectric sensor
$s_{46}$	force + pressure + laser	$s_{125}$	ultra-sonic sensor + magnetic sensor + camera
$s_{47}$	force sensors + laser + GPS + INS	$s_{126}$	laser + camera + tempo sonics

$s_{48}$	work environment sensors + GPS + IMU + lidar	$s_{127}$	3D sensor
$s_{49}$	infrared sensor	$s_{128}$	force sensor + pressure sensor + provision sensor + vision sensors
$s_{50}$	position sensor + force sensor	$s_{129}$	optical + ultrasonic + laser
$s_{51}$	bump sensor	$s_{130}$	camera + pressure sensor + displacement sensor
$s_{52}$	on-board camera + live video + inductive sensors	$s_{131}$	gyroscopes, force/torque sensor, video cameras
$s_{53}$	lidar + distance sensor + IMU + inductive sensor + contact sensors	$s_{132}$	CCD cameras + acceleration sensors + position sensors + magnetic stroke sensors
$s_{54}$	laser + cameras + Kinect	$s_{133}$	stereo camera + acceleration sensors
$s_{55}$	load cell sensor	$s_{134}$	magnetic stroke sensors + pressure sensors + stereo camera
$s_{56}$	ultrasonic + position camera	$s_{135}$	force sensor + tracker sensor + stereo camera
$s_{57}$	environmental sensor	$s_{136}$	camera + position + pressure
$s_{58}$	F/T sensors force/torque + environmental sensor	$s_{137}$	position sensors + magnetic stroke sensors + pressure sensors
$s_{59}$	position and forces sensor	$s_{138}$	axis sensors
$s_{60}$	infrared sensor + force sensor + camera	$s_{139}$	stereo camera + acceleration sensors + a gyro sensor
$s_{61}$	optical sensor + camera	$s_{140}$	pressure sensor + electronic compass + displacement transducers
$s_{62}$	IMU	$s_{141}$	angle sensor + ultrasonic sensors
$s_{63}$	proximity sensor + multiple sensors + camera	$s_{142}$	light sensors + humidity/temperature sensors + sonar sensors + ultrasonic range sensor + infrared distance measuring sensors + CMOS image sensor
$s_{64}$	force + laser	$s_{143}$	GPS + IMU
$s_{65}$	camera + tactile	$s_{144}$	camera + angle + lidar + GPS
$s_{66}$	GPS, position sensor, reference sensor	$s_{145}$	attitude sensor + acceleration sensor + camera, displacement sensor
$s_{67}$	GPS	$s_{146}$	Kinect + accelerometers + IMUs
$s_{68}$	GPS + inclinometer	$s_{147}$	webcam
$s_{69}$	GPS + laser	$s_{148}$	IMU + camera
$s_{70}$	laser + position	$s_{149}$	force-torque sensor + camera/vision
$s_{71}$	force-torque + photoelectric sensor	$s_{150}$	RGB LED
$s_{72}$	camera + proximity sensor + F/T sensor	$s_{151}$	height sensor
$s_{73}$	tilt sensor + distance sensor + camera + laser scanner, gyroscope	$s_{152}$	stroke sensor + temperature sensor + hydraulic sensor + potentiometer
$s_{74}$	ultrasonic sensor + displacement transducers + ranging transducer + laser scanner	$s_{153}$	RFID + humidity sensor + temperature sensor + Kinect Sensor
$s_{75}$	laser distance + stereo infrared sensor	$s_{154}$	equivalent sensor
$s_{76}$	distance sensor	$s_{155}$	presence sensor + IR interrupt sensor + LVDT inductive sensors
$s_{77}$	force sensor + pose sensor	$s_{156}$	RGB camera + IMU
$s_{78}$	actuators and electronic sensors + stop sensor	$s_{157}$	Zigbee sensors + laser finder
$s_{79}$	lidar + camera	$s_{158}$	depth sensor + colour sensors + camera

## ● hardware design labels

label	contents	label	contents
<i>bd<sub>1</sub></i>	humanoid	<i>bd<sub>42</sub></i>	mobile vehicle + aerial lift + manipulator + vacuum suction device
<i>bd<sub>2</sub></i>	arm, manipulator, mounted	<i>bd<sub>44</sub></i>	manipulator + vacuum suction + wheel mobility
<i>bd<sub>3</sub></i>	crawler	<i>bd<sub>45</sub></i>	wearable
<i>bd<sub>4</sub></i>	arm + slider pulley	<i>bd<sub>46</sub></i>	wheel + magnetic gripper
<i>bd<sub>5</sub></i>	multi-fingered, hand + gear + belt	<i>bd<sub>47</sub></i>	mobile formwork
<i>bd<sub>6</sub></i>	tank	<i>bd<sub>48</sub></i>	reconfigurable + vacuum grippers+ arm +two robot
<i>bd<sub>7</sub></i>	gantry robot, arm	<i>bd<sub>49</sub></i>	robotized crane
<i>bd<sub>8</sub></i>	mobile robotic platform/robot	<i>bd<sub>50</sub></i>	vacuum cups+ overhead gantry crane
<i>bd<sub>9</sub></i>	AGV, track lifting arm	<i>bd<sub>51</sub></i>	omnidirectional wheel, mobile platform, vacuum generator, robotic arm
<i>bd<sub>10</sub></i>	traveling crane	<i>bd<sub>52</sub></i>	mobile vehicle, carriage, truck, excavator, tank, trolley, dozer, Caterpillar, Forklift, machine
<i>bd<sub>11</sub></i>	lifting rail + moved arm + carriage	<i>bd<sub>53</sub></i>	wireless gripper, winch
<i>bd<sub>12</sub></i>	fixed arm (depicted, mounted, hang on, manipulator, attach)	<i>bd<sub>54</sub></i>	vacuum gripper + arm
<i>bd<sub>13</sub></i>	mobile platform + arm, manipulator	<i>bd<sub>55</sub></i>	vertically mobile arm
<i>bd<sub>14</sub></i>	changeable cell	<i>bd<sub>56</sub></i>	rail moving arm
<i>bd<sub>15</sub></i>	wheel mobile lifting single arm	<i>bd<sub>57</sub></i>	wire, cable climb
<i>bd<sub>16</sub></i>	climbing platform + pediculate + gripper	<i>bd<sub>58</sub></i>	UAV
<i>bd<sub>17</sub></i>	lift fixed manipulator	<i>bd<sub>59</sub></i>	scissor lift + aerial bucket + manipulator arm
<i>bd<sub>18</sub></i>	the legged mobile platform with rods climbs	<i>bd<sub>60</sub></i>	truss-type
<i>bd<sub>19</sub></i>	climbing platforms + vacuum grippers + suction	<i>bd<sub>61</sub></i>	excavator arm + double front
<i>bd<sub>20</sub></i>	climbing two platforms + light skeleton + vacuum grippers	<i>bd<sub>62</sub></i>	caterpillar + 6-DOF manipulator + vacuum pad
<i>bd<sub>21</sub></i>	mobile arm	<i>bd<sub>63</sub></i>	scissor-jack manipulator
<i>bd<sub>22</sub></i>	mobility platform + magnetic gripper	<i>bd<sub>64</sub></i>	ground-based, aerial robotic platform
<i>bd<sub>23</sub></i>	mobile + light + manipulator + rail	<i>bd<sub>65</sub></i>	mobile square
<i>bd<sub>24</sub></i>	climbing system	<i>bd<sub>66</sub></i>	mobile tracked locomotion
<i>bd<sub>25</sub></i>	parallel robot	<i>bd<sub>67</sub></i>	frame system
<i>bd<sub>26</sub></i>	rail, vertical-moving robot	<i>bd<sub>68</sub></i>	mobile platform Husky
<i>bd<sub>27</sub></i>	AGV, unmanned ground vehicle	<i>bd<sub>69</sub></i>	platform clamp
<i>bd<sub>28</sub></i>	Hexapod-Shaped	<i>bd<sub>70</sub></i>	mobility feet, leg, limbed
<i>bd<sub>29</sub></i>	a mobile platform, a manipulator mounted on a lifting column	<i>bd<sub>71</sub></i>	wheel + platform + caterpillar
<i>bd<sub>30</sub></i>	industrial robot, ABB arm, arm, KUKA arm, Mitsubishi Robot RV-2AJ, manipulator, UR5	<i>bd<sub>72</sub></i>	Hammering
<i>bd<sub>31</sub></i>	UGV + UAV	<i>bd<sub>73</sub></i>	magnetic wheel
<i>bd<sub>32</sub></i>	wheel mobile robot	<i>bd<sub>74</sub></i>	worm-like, snake-like
<i>bd<sub>33</sub></i>	bucket + arm	<i>bd<sub>75</sub></i>	clamping manipulator
<i>bd<sub>34</sub></i>	vertical mobile + cleaning head + pressure pump + suction device + filter + tank	<i>bd<sub>76</sub></i>	scissor lifter + omnidirectional wheels
<i>bd<sub>35</sub></i>	magnetic clamp and mobile platform	<i>bd<sub>77</sub></i>	bolting robot
<i>bd<sub>36</sub></i>	mobile arm, manipulator + wheels	<i>bd<sub>78</sub></i>	collaborative, multi, team, multiple

<i>bd<sub>37</sub></i>	reconfigurable + platform	<i>bd<sub>79</sub></i>	omnidirectional wheel
<i>bd<sub>38</sub></i>	reconfigurable + vertical + climbing	<i>bd<sub>80</sub></i>	3d printer, lifting
<i>bd<sub>39</sub></i>	reconfigurable + locomotive wheel	<i>bd<sub>81</sub></i>	motion base, manipulator
<i>bd<sub>40</sub></i>	caterpillar wheel + commercial impeller, + vacuum suction	<i>bd<sub>82</sub></i>	artificial Nbber/ Rubber muscle (PARM)
<i>bd<sub>41</sub></i>	parallel manipulator, frame	<i>bd<sub>83</sub></i>	furniture system, terminal wall system

## ● benchmarking technique labels

label	contents
<i>bm<sub>1</sub></i>	environmental + life cycle Assessment (LCA)
<i>bm<sub>2</sub></i>	technical + economic + efficiency
<i>bm<sub>3</sub></i>	efficiency
<i>bm<sub>4</sub></i>	motion + force + transmissibility
<i>bm<sub>5</sub></i>	safety + posture load + working environment + risk exposure time+ safety
<i>bm<sub>6</sub></i>	cost + quality
<i>bm<sub>7</sub></i>	productivity + economic + sensitivity + safety + quality
<i>bm<sub>8</sub></i>	cost + productivity + sensitivity
<i>bm<sub>9</sub></i>	material management
<i>bm<sub>10</sub></i>	position + internal + error + force
<i>bm<sub>11</sub></i>	grasping + force + perception
<i>bm<sub>12</sub></i>	sustainability +performance + environment
<i>bm<sub>13</sub></i>	error + cost + power consumption + controllability + complexity continuous time
<i>bm<sub>14</sub></i>	cost + productivity + efficiency
<i>bm<sub>15</sub></i>	mental workload