- **actuation method, hardware control labels**

label	contents
a_1	pneumatic
a_2	hydraulic
a_3	motor
a_4	electro and hydraulic
a_5	pneumatic and motor
a_6	cable-driven

- **hardware control labels**

label	contents
ch_1	remote operator control
ch_2	automatic control
ch_3	human-robot collaboration
ch_4	manual control

- **application labels**

label	contents	label	contents	label	contents
A_1	road construction	A_{22}	masonry construction	A_{43}	joint filling
A_2	titling 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_{26}	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
cc_1	SFT algorithm, NNG algorithm	cc_{61}	pixels regression
cc_2	kinematic	cc_{62}	image processing
cc_3	analytical model	cc_{63}	Actuator-level languages
cc_4	estimate ego-position	cc_{64}	iterative algorithms + regression model
cc_5	PI controller, active control algorithm	cc_{65}	path-planning
cc_6	pure-pursuit method	cc_{66}	geodetical method
cc_7	Dijkstra's algorithm	cc_{67}	Kalman Filter Algorithm
cc_8	tractive thrust, numerical simulation	cc_{68}	Msc. Adams and Matlab/Simulink programs
cc_9	performance test, evaluation	cc_{69}	dynamic model
cc_{10}	heuristic algorithm, heuristics	cc_{70}	PTP control
cc_{11}	Mesh Mould	cc_{71}	TCP control
cc_{12}	path planning-linear interpolation algorithm-TP language	cc_{72}	Particle Swarm Optimization (PSO) algorithms
cc_{13}	NDT-method	cc_{74}	RFID
cc_{14}	control travel speed	cc_{75}	IFC + BIM
cc_{15}	automated off-line teaching system	cc_{76}	LPA* algorithm
cc_{16}	user datagram protocol (UDP)	cc_{77}	digital signal processing (DSP) controller
cc_{17}	admittance control	cc_{78}	torque measure methods
cc_{18}	CAN-communication	cc_{79}	RBF-PID Control, PID
cc_{19}	simplified error analysis model	$cc8_0$	augmented reality techniques (AR)
cc_{20}	vision based gesture estimation, CARLoS Scenario	cc_{81}	predictive force method
cc_{21}	optimizing welding sequence	cc_{82}	Generalized Resolution Correlative Scan Matching (GRCSM)
cc_{22}	BIM+ Augmented Reality+Human-Machine Interfaces (IMUs)	cc_{83}	finite element method
cc_{23}	power line communication net	cc_{84}	Force feedback control
cc_{24}	beacon-based localization method	cc_{85}	iterative learning control, fuzzy logic controller
cc_{25}	a search algorithm.	cc_{86}	master-slave system
cc_{26}	fusion fuzzy, fuzzy logic, fuzzy set theory	cc_{87}	improved Bug-based path planning algorithm
cc_{27}	distributed feedback mechanism	cc_{88}	"point-to-angle" algorithms
cc_{28}	motion simulation	cc_{89}	trajectory generation algorithm
cc_{29}	planning and stigmergy, Linux-based computer	cc_{90}	C++, Java, C# script, C program
cc_{30}	encoder failure detection algorithm	cc_{91}	pre-acting control algorithm
cc_{31}	wireless communication, wireless Lan	cc_{92}	Virtual Reality
cc_{32}	parametric-integrated algorithm, parametric synthesis	cc_{93}	bar penetration technique, in-process reinforcing technique
cc_{33}	Brooks' algorithm	cc_{94}	Raspberry Pi
cc_{34}	Anderson Passive control theory	cc_{95}	PLC
cc_{35}	BIM, prepare the trajectories	cc_{96}	real time navigation
cc_{36}	PID position control	cc_{97}	cost optimization
cc_{37}	intelligent beacon	cc_{98}	tree-Based algorithm
cc_{38}	least squares algorithm	cc_{99}	dedicated smart sensors

cc_{39}	voltage response	cc_{100}	markov chains
cc_{40}	collision avoidance algorithms, feed forward control algorithms	cc_{101}	robust algorithm
cc_{41}	timing algorithm	cc_{102}	MPEG algorithm, the pair-wise alignment algorithm, Minimum V variance Matching (MVM) Algorithm
cc_{42}	HyperCard program	cc_{103}	motion planning
cc_{43}	inverse kinematic and dynamic models	cc_{104}	integral monitoring system
cc_{44}	3D printer/printing	cc_{105}	A* algorithm, A-star
cc_{45}	discrete event simulation model	cc_{106}	point cloud data control
cc_{46}	embedded, embedding, controller	cc_{107}	random walk algorithm
cc_{47}	UML state charts and capsules	cc_{108}	positioning system
cc_{48}	Hierarchical planning	cc_{109}	stereovision method
cc_{49}	genetic algorithms (GA)	cc_{110}	Iterative Closest Point (ICP) algorithm
cc_{50}	simple kinematic connection	cc_{111}	measures vector value of vertical lifting
cc_{51}	Iterative Inverse Perspective Matching algorithm	cc_{112}	Ubiquitous Sensor Network
cc_{52}	longest common subsequence (LCS)	cc_{113}	velocity control
cc_{53}	forward and inverse geometric model	cc_{114}	behaviour-based system
cc_{54}	inverse position equation	cc_{115}	self-positioning algorithm
cc_{55}	teaching robots' specific skills	cc_{116}	segmentation approach
cc_{56}	best-fit algorithms	cc_{117}	automatic battery replacement
cc_{57}	C-K Theory	cc_{118}	SLAM
cc_{58}	soft additive fabrication	cc_{119}	error modification
cc_{59}	primitive static states	cc_{120}	estimate the distance between robot to wall
cc_{60}	workflow method		
cc_{73}	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
s_1	laser + ultrasonic + CCD camera	s_{80}	infrared + camera
s_2	camera + pressure sensor + force sensor + magnetostriction sensor + tactile sensor, gyro	s_{81}	angle sensor
s_3	position sensor + camera	s_{82}	laser + lidar
s_4	image sonars + camera + LBL, gyro	s_{83}	IMU + laser
s_5	pressure sensor + tactile sensor	s_{84}	GPS + lidar + camera + angle sensors + distance sensors + force sensor + depth sensor + radar, ultrasonic sensors + IMU
s_6	torque/force sensor + force sensor	s_{85}	pressure sensor + speed sensor + proximity sensors
s_7	camera	s_{86}	range sensor + displacement sensor + GPS
s_8	pressure sensor	s_{87}	range sensors + distance sensor
s_9	visual sensor	s_{88}	pressure sensors + laser sensor
s_{10}	ultrasonic	s_{89}	liquid based sensor
s_{11}	visual sensor + touch sensor + optical detector + arc weaving sensor	s_{90}	IR sensor + F/T sensor + acceleration sensor
s_{12}	tactile sensing system + welding sensor	s_{91}	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 senser	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 + magneto strictive 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}	a 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
b_1	humanoid	b_{42}	mobile vehicle, aerial lift, manipulator, vacuum suction device
b_2	arm, manipulator, mounted on vehicle, track, excavator, caterpillar, lorry, rail, crawler, crane, car	b_{44}	manipulator, vacuum suction, wheel mobility
b_3	crawler	b_{45}	wearable
b_4	arm, slider pulley	b_{46}	wheel mobile, magnetic gripper
b_5	multi-fingered robot hand, gear, belt	b_{47}	mobile formwork
b_6	tank	b_{48}	reconfigurable, vacuum grippers, arm, two robots

b_7	gantry robot, arm	b_{49}	crane, robotized crane
b_8	mobile robotic platform/robot	b_{50}	vacuum cups, overhead gantry crane
b_9	AGV, track lifting arm	b_{51}	omnidirectional wheel, mobile platform, vacuum generator, robotic arm
b_{10}	traveling crane	b_{52}	mobile vehicle, carriage, truck, excavator, tank, trolley, dozer, Caterpillar, Forklift, machine
b_{11}	lifting rail, and arm moved by carriage	b_{53}	wireless gripper, winch
b_{12}	fixed arm (depicted, mounted, hang on, manipulator, attach)	b_{54}	vacuum gripper and robot arm
b_{13}	mobile platform arm, manipulator	b_{55}	vertically mobile arm
b_{14}	changeable cell	b_{56}	rail moving arm,
b_{15}	wheel mobile lifting single arm	b_{57}	wire robot, cable climb
b_{16}	climbing platform, pediculate, gripper	b_{58}	UAV
b_{17}	lift fixed manipulator	b_{59}	a scissor lift, aerial bucket, and a manipulator arm
b_{18}	the legged mobile platform with rods climbs	b_{60}	truss-type robot
b_{19}	climbing platforms, with vacuum grippers and suction	b_{61}	double arm excavator arm, double front, dual arm
b_{20}	climbing two platforms and a light skeleton, vacuum grippers	b_{62}	caterpillar and, 6-DOF manipulator with vacuum pad
b_{21}	mobile arm	b_{63}	scissor-jack type manipulator
b_{22}	mobility platform and magnetic gripper	b_{64}	ground-based, aerial robotic platform
b_{23}	mobile robot, a light automatic manipulator moves by rail	b_{65}	mobile square
b_{24}	climbing system	b_{66}	mobile tracked locomotion
b_{25}	parallel robots	b_{67}	frame system
b_{26}	rail, vertical-moving robot	b_{68}	mobile platform Husky
b_{27}	AGV, unmanned ground vehicle	b_{69}	platform clamp
b_{28}	Hexapod-Shaped	b_{70}	mobility feet, leg, limbed
b_{29}	a mobile platform, a manipulator mounted on a lifting column	b_{71}	wheel mobile platform, caterpillar
b_{30}	ABB arm, arm, KUKA arm, Mitsubishi Robot RV-2AJ, manipulator, UR5	b_{72}	Hammering Robot
b_{31}	UGV and UAV	b_{73}	magnetic wheel
b_{32}	wheel mobile robot	b_{74}	worm-like, snake-like robot
b_{33}	bucket, arm	b_{75}	mobility, clamping manipulator
b_{34}	vertical mobile, a cleaning head, a pressure pump, a suction device, a filter and a tank.	b_{76}	scissor lifter and omnidirectional wheels
b_{35}	magnetic clamp and mobile platform	b_{77}	bolting robot
b_{36}	mobile arm, manipulator with wheels	b_{78}	collaborative robots, multi robot, team of robots, multiple
b_{37}	mobile reconfigurable, platform	b_{79}	omnidirectional wheel
b_{38}	reconfigurable vertical climbing	b_{80}	3d printer, lifting
b_{39}	reconfigurable with locomotive wheels	b_{81}	motion base, manipulator
b_{40}	caterpillar wheels, commercial impeller, vacuum suction	b_{82}	artificial Nbber/ Rubber muscle (PARM)
b_{41}	parallel manipulator, frame	b_{83}	a novel furniture system, terminal wall system

benchmarking technique labels

label	contents
ce_1	the environmental impact, life cycle Assessment (LCA)
ce_2	technical, economic, efficiency
ce_3	efficiency
ce_4	motion/force transmissibility
ce_5	safety, posture load, working environment, risk exposure time, safety improvement ratio
ce_6	cost optimization, quality control functions
ce_7	productivity, economic feasibility, sensitivity, safety improvement, quality improvement
ce_8	life cycle cost, productivity, sensitivity analysis
ce_9	material management
ce_{10}	position error, internal error, force
ce_{11}	tele grasping force perception
ce_{12}	sustainability performance, environment
ce_{13}	error, cost, power consumption, controllability, complexity continuous time
ce_{14}	cost, productivity, efficiency
ce_{15}	mental workload