- occurrence probability of TcA_i related papers

Term labels	Subcategory labels						Papers (title)	Probability	Publication years
	s_i		cc_i		A_i				
$Tc_{172}A_{54}$	s_{11}	0.0100	cc_{12}	0.0032	A_{54}	0.0379	Arc Welding Robot Systems for Large Steel Constructions	0.00012076	1983
$Tc_{181}A_{55}$		0.0050	cc_{2}	0.0032	A_{55}	0.0275	Walking robot for underwater construction	0.00004391	1983
$Tc_{237}A_{54}$	s_{11}	0.0100	cc_{120}	0.0064	A_{54}	0.0379	Arc welding robot with maximum flexibility for large steel construction	0.00024152	1984
$Tc_{236}A_{54}$		0.0050	cc_{8}	0.0032	A_{54}	0.0379	Application of intelligent robot arc-welding system to large-sized steel	0.00006038	1985
$Tc_{171}A_{54}$		0.0050	cc_{13}	0.0032	A_{54}	0.0379	Robotized welding of large offshore constructions	0.00006038	1986
$Tc_{43}A_{14}$	s_{125}	0.0050	cc_{120}	0.0064	A_{14}	0.0138	Development of positioning systems for autonomous robots on construction sites	0.00004391	1989
$Tc_{97}A_{31}$		0.0050	cc_{42}	0.0128	A_{31}	0.0069	Framework for construction robot fleet management system	0.00004391	1990
$Tc_{7}A_{1}$	s_{65}	0.0050	cc_{63}	0.0032	A_{1}	0.0189	Automation and robotics for road construction and maintenance	0.00003019	1990
$Tc_{19}A_{50}$	s_{33}	0.0100	cc_{36}	0.0192	A_{50}	0.0516	Position-force adaptive control of a robot with applications in construction	0.00098804	1991
$Tc_{11}A_{20}$	s_{34}	0.0050	cc_{36}	0.0192	A_{20}	0.0138	Automation of surface treatment in construction by using a robot	0.00013174	1991
$Tc_{97}A_{31}$		0.0050	cc_{42}	0.0128	A_{31}	0.0069	Construction robot fleet management system prototype	0.00098804	1991
$Tc_{115}A_{4}$	s_{76}	0.0050	cc_{95}	0.0096	A_{4}	0.0017	SSR: a mobile robot on ferromagnetic surfaces	0.00000823	1992
$Tc_{82}A_{24}$		0.0050	cc_{33}	0.0032	A_{24}	0.0224	Real-time robot path planning using the potential function method	0.00003568	1993
$Tc_{64}A_{20}$	s_{6}	0.0846	cc_{38}	0.0064	A_{20}	0.0138	Position-force adaptive control for construction robots		
$Tc_{97}A_{7}$		0.0050	cc_{42}	0.0128	A_{7}	0.0207	Managing multiple construction robots with a computer	0.00074652	1993
$Tc_{106}A_{32}$	s_{39}	0.2289	cc_{52}	0.0032	A_{32}	0.0310	Model-based guidance by the longest common subsequence algorithm for indoor autonomous vehicle navigation using computer vision	0.00010704	1993

$Tc_{80}A_{24}$	s_{10}	0.0050	cc_{65}	0.0096	A_{24}	0.0224	Map representation of a large in-door environment with path planning and navigation abilities for an autonomous mobile robot with its implementation on a real robot	0.00010704	1993
$Tc_{13}A_{14}$		0.0050	cc_{115}	0.0224	A_{14}	0.0138	Self-Position Measuring Method for Moving Robot Working at Construction Sites	0.00015370	1994
$Tc_{97}A_{48}$		0.0050	cc_{42}	0.0128	A_{48}	0.0034	Logistics Support System for Construction Robotics Implementation	0.00002196	1994
$Tc_{87}A_{50}$		0.0050	cc_{5}	0.0160	A_{50}	0.0516	Study on active vibration control of arm for construction machinery – modelling and linear-control simulation	0.00041168	1994
$Tc_{75}A_{22}$	s_{74}	0.0050	cc_{73}	0.1282	A_{22}	0.0534	Path planning and sensing for an experimental masonry building robot	0.00340326	1994
$Tc_{137}A_{45}$	s_{50}	0.0050	cc_{79}	0.0256	A_{45}	0.0241	Construction robot force control in cleaning operations	0.00030739	1994
$Tc_{51}A_{50}$	s_{22}	0.0100	cc_{10}	0.0096	A_{50}	0.0516	On the dynamic control of a hydraulic large range robot for construction applications	0.00049402	1995
$Tc_{84}A_{24}$		0.0050	cc_{103}	0.0224	A_{24}	0.0224	A behavioral language for motion planning in building construction	0.00024976	1995
$Tc_{84}A_{34}$		0.0050	cc_{103}	0.0224	A_{34}	0.0413	Integration of CAD drawings and construction robot motion controllers	0.00046109	1996
$Tc_{164}A_{50}$		0.0050	cc_{114}	0.0128	A_{50}	0.0516	Construction robot for three-dimensional shapes based on the nesting behavior of paper wasps	0.00032935	1996
$Tc_{13}A_{14}$		0.0050	cc_{115}	0.0224	A_{14}	0.0138	Self-position measuring method for moving robot working at construction sites (2nd report, improvement of pillar-detecting algorithm)	0.00015370	1996
$Tc_{79}A_{22}$	s_{21}	0.0050	cc_{70}	0.0096	A_{22}	0.0534	Controlled hydraulics for a direct drive brick laying robot	0.00025524	1996
$Tc_{116}A_{58}$		0.0050	cc_{70}	0.0096	A_{58}	0.0069	Development of interior finishing unit assembly system with robot: WASCOR IV research project report	0.00003293	1996
$Tc_{78}A_{22}$	s_{1}	0.0149	cc_{71}	0.0032	A_{22}	0.0534	Technological aspects in the development of a mobile bricklaying robot	0.00025524	1996
$Tc_{27}A_{11}$		0.0050	cc_{90}	0.0256	A_{11}	0.0551	Automatic generation of the controlling-system for a wall construction robot	0.00070261	1996
$Tc_{140}A_{46}$	s_{1}	0.0149	cc_{121}	0.0032	A_{46}	0.0052	Robotic mapping of building interior - Precision analysis	0.00002470	1997

$Tc_{170}A_{54}$	s_{14}	0.0697	cc_{14}	0.0032	A_{54}	0.0379	Steel frame welding robot systems and their application at the construction site	0.00084533	1997
$Tc_{117}A_{34}$	s_{70}	0.0050	cc_{26}	0.0256	A_{34}	0.0413	Robot assembly system for the construction process automation	0.00052696	1997
$Tc_{189}A_{32}$		0.0050	cc_{26}	0.0256	A_{32}	0.0310	A fuzzy navigation system for mobile construction robots	0.00039522	1997
$Tc_{189}A_{56}$		0.0050	cc_{26}	0.0256	A_{56}	0.0688	Feasibility of automating military's environmental operations	0.00087826	1997
$Tc_{60}A_{53}$	s_{14}	0.0697	cc_{46}	0.0128	A_{53}	0.0069	Development of a distributed multiple mobile robot control system for automatic highway maintenance and construction	0.00061478	1997
$Tc_{33}A_{12}$		0.0050	cc_{49}	0.0160	A_{12}	0.0241	Selection of optimal construction robot using genetic algorithm	0.00019212	1997
$Tc_{121}A_{26}$	s_{154}	0.0050	cc_{90}	0.0256	A_{26}	0.0052	The development of a rapid-prototyping technique for mechatronic-augmented heavy plant	0.00006587	1997
$Tc_{42}A_{53}$	s_{54}	0.1393	cc_{90}	0.0256	A_{53}	0.0069	Distributed control of a multiple tethered mobile robot system for highway maintenance and construction	0.00245913	1997
$Tc_{205}A_{50}$		0.0050	cc_{92}	0.0064	A_{50}	0.0516	Programming construction robots using virtual reality techniques	0.00016467	1997
$Tc_{29}A_{12}$	s_{39}	0.2289	cc_{96}	0.0096	A_{12}	0.0241	Vision-based interactive path planning for robotic bridge paint removal	0.00530250	1997
$Tc_{6}A_{1}$	s_{66}	0.0050	cc_{64}	0.0064	A_{1}	0.0189	A new facility for testing accurate positioning systems for road construction robotics	0.00006038	1998
$Tc_{5}A_{1}$	s_{67}	0.0050	cc_{65}	0.0096	A_{1}	0.0189	AutoPave: Towards an automated paving system for asphalt pavement compaction operations	0.00009057	1998
$Tc_{4}A_{1}$	s_{6}	0.0846	cc_{73}	0.1282	A_{1}	0.0189	Automated and robotics-based techniques for road construction	0.02052933	1998
$Tc_{31}A_{12}$	s_{94}	0.0050	cc_{96}	0.0096	A_{12}	0.0241	Automation infrastructure system for a robotic 30-ton bridge crane	0.00011527	1998
$Tc_{200}A_{56}$		0.0050	cc_{81}	0.0032	A_{56}	0.0688	Teleoperation control of ETS-7 robot arm for on-orbit truss construction	0.00010978	1999

$Tc_{70}A_{38}$		0.0050	cc_{89}	0.0096	A_{38}	0.0155	Development of a Construction Robot for Marking on Ceiling Boards: 2nd Report, Drawing a Long Straight Line on the Ceiling	0.00007410	1999
$Tc_{118}A_{34}$	s_{138}	0.0050	cc_{26}	0.0256	A_{34}	0.0413	Robot assembly system for computer-integrated construction	0.00052696	2000
$Tc_{226}A_{7}$	s_{44}	0.0050	cc_{43}	0.0064	A_{7}	0.0207	Impedance control of a hydraulically actuated robotic excavator	0.00006587	2000
$Tc_{57}A_{2}$	s_{39}	0.2289	cc_{61}	0.0032	A_{2}	0.0086	Process and quality control with a video camera, for a floor-tilling robot	0.00063125	2000
$Tc_{169}A_{12}$		0.0050	cc_{15}	0.0032	A_{12}	0.0241	Development of a teachingless robot system for welding a large-sized box-type construction	0.00003842	2001
$Tc_{54}A_{19}$	s_{118}	0.0050	cc_{115}	0.0224	A_{19}	0.0138	LAN-based building maintenance and surveillance robot	0.00015370	2002
$Tc_{41}A_{14}$	s_{39}	0.2289	cc_{56}	0.0032	A_{14}	0.0138	A framework for rapid local area modeling for construction automation	0.00101000	2002
$Tc_{224}A_{7}$	s_{45}	0.0050	cc_{89}	0.0096	A_{7}	0.0207	Automated excavation in construction using robotics trajectory and envelop generation	0.00009880	2002
$Tc_{95}A_{30}$	s_{6}	0.0846	cc_{100}	0.0032	A_{30}	0.0103	Blind Bulldozing: Multiple Robot Nest Construction	0.00027995	2003
$Tc_{124}A_{38}$	s_{14}	0.0697	cc_{115}	0.0224	A_{38}	0.0155	Development of a construction robot for marking on ceiling boards (3rd report, prototype of the laser pointer system)	0.00242070	2003
$Tc87A_{26}$	s_{8}	0.0199	cc_{5}	0.0160	A_{26}	0.0052	Application of Robots Using Pneumatic Artificial Rubber Muscles for Operating Construction Machines	0.00016467	2003
$Tc_{144}A_{5}$	s_{86}	0.0050	cc_{87}	0.0032	A_{5}	0.0120	Construction robot path-planning for earthwork operations	0.00001921	2003
$Tc_{187}A_{56}$		0.0050	cc_{31}	0.0160	A_{56}	0.0688	Field test of remote control system for construction machines using robot arm	0.00054891	2004
$Tc_{187}A_{56}$		0.0050	cc_{31}	0.0160	A_{56}	0.0688	Development of remote control system of construction machinery using pneumatic robot arm	0.00054891	2004
$Tc_{138}A_{45}$	s_{33}	0.0100	cc_{43}	0.0064	A_{45}	0.0241	Analysis of a climbing parallel robot for construction applications	0.00015370	2004
$Tc_{222}A_{7}$	s_{47}	0.0050	cc_{47}	0.0032	A_{7}	0.0207	A control architecture for robotic excavation in construction	0.00003293	2004

$Tc_{33}A_{12}$		0.0050	cc_{49}	0.0160	A_{12}	0.0241	Application of GA in optimal robot selection for bridge restoration	0.00019212	2004
$Tc_{182}A_{55}$	s_1	0.0149	cc_{62}	0.0224	A_{55}	0.0275	The study of remotely teleoperated robotic manipulator system for underwater construction	0.00092217	2004
$Tc_{56}A_2$	s_{54}	0.1393	cc_{62}	0.0224	A_2	0.0086	Real-time Sense-and-Act' operation for construction robots	0.00268967	2004
$Tc_{76}A_{24}$		0.0050	cc_{73}	0.1282	A_{24}	0.0224	Spatial model for path planning of multiple mobile construction robots	0.00142717	2004
$Tc_{216}A_6$	s_{54}	0.1393	cc_{102}	0.0032	A_6	0.0723	Automating inspection and documentation of remote building construction using a robotic camera	0.00322761	2005
$Tc_{26}A_{11}$	s_{22}	0.0100	cc_{25}	0.0064	A_{11}	0.0551	A heavy climbing robotic platform for geotechnical applications	0.00035130	2005
$Tc_{23}A_{11}$	s_{23}	0.0050	cc_{26}	0.0256	A_{11}	0.0551	Climbing robots with adaptive grippers for construction	0.00070261	2005
$Tc_{93}A_3$	s_{39}	0.2289	cc_{36}	0.0192	A_3	0.0069	A hybrid pole climbing and manipulating robot with minimum DOFs for construction and service applications	0.00303000	2005
Tc_3A_1	s_{54}	0.1393	cc_{67}	0.0064	A_1	0.0189	Robotic systems for pavement lane painting operations	0.00169065	2005
$Tc_{132}A_{42}$	s_{14}	0.0697	cc_{109}	0.0064	A_{42}	0.0086	Example of experimental use of 3D measurement system for construction robot based on component design concept	0.00038424	2006
$Tc_{232}A_{51}$	s_{87}	0.0100	cc_{109}	0.0064	A_{51}	0.0052	Pose estimation of construction materials using multiple id devices for construction automation	0.00003293	2006
$Tc_{55}A_{19}$	s_{38}	0.0050	cc_{114}	0.0128	A_{19}	0.0138	Sustainable cooperative robotic technologies for human and robotic outpost infrastructure construction and maintenance	0.00008783	2006
$Tc_{22}A_{11}$	s_{24}	0.0050	cc_{27}	0.0032	A_{11}	0.0551	A distributed feedback mechanism to regulate wall construction by a robotic swarm	0.00008783	2006
$Tc_{105}A_{32}$	s_{142}	0.0050	cc_{31}	0.0160	A_{32}	0.0310	Wireless sensor-driven intelligent navigation robots for indoor construction site security and safety	0.00024701	2006
$Tc_{154}A_{50}$		0.0050	cc_{46}	0.0128	A_{50}	0.0516	Control architecture characteristics for intelligence in autonomous mobile construction robots	0.00032935	2006

$Tc_{145}A_5$	s_{87}	0.0100	cc_{65}	0.0096	A_5	0.0120	Closure to "construction robot path-planning for earthwork operations" by Sung-Keun Kim, Jeffrey S. Russell, and Kyo-Jin Koo	0.00011527	2006
Tc_2A_1	s_{68}	0.0050	cc_{68}	0.0032	A_1	0.0189	A 3D model based control of an excavator	0.00003019	2006
Tc_1A_1	s_{69}	0.0050	cc_{69}	0.0032	A_1	0.0189	Autonomous robot for pavement construction in challenging environments	0.00003019	2006
$Tc_{197}A_{50}$	s_{81}	0.0100	cc_{79}	0.0256	A_{50}	0.0516	Research on RBF-PID control for the 6-DOF motion base in construction tele-robot system	0.00131739	2006
$Tc_{27}A_8$	s_{39}	0.2289	cc_{90}	0.0256	A_8	0.0293	Development of a real-time control system architecture for automated steel construction	0.01716999	2006
$Tc_{215}A_6$	s_{39}	0.2289	cc_{103}	0.0224	A_6	0.0723	The study in using an autonomous robot for pavement inspection	0.03711747	2007
$Tc_{93}A_{56}$	s_{39}	0.2289	cc_{36}	0.0192	A_{56}	0.0688	Graphical modeling and simulation for design and control of a tele-operated clinker clearing robot	0.03029998	2007
$Tc_{33}A_{50}$		0.0050	cc_{49}	0.0160	A_{50}	0.0516	A multicriteria approach for the optimal design of 2 DOF parallel robots used in construction applications	0.00041168	2007
$Tc_{76}A_{52}$		0.0050	cc_{73}	0.1282	A_{52}	0.0103	Modified stereo vision calibration method for construction robot	0.00065870	2007
$Tc_{199}A_{56}$	s_{39}	0.2289	cc_{80}	0.0096	A_{56}	0.0688	Development of immersive Augmented Reality Interface for Construction Robotic System	0.01514999	2007
$Tc_{229}A_8$		0.0050	cc_{91}	0.0032	A_8	0.0293	Pre-acting manipulator for shock isolation in steel construction	0.00004666	2007
$Tc_{168}A_{54}$		0.0050	cc_{16}	0.0032	A_{54}	0.0379	Construction of welding robot network control system	0.00006038	2008
$Tc_{89}A_{29}$	s_{114}	0.0050	cc_{36}	0.0192	A_{29}	0.0310	Development of prototype of a unmanned transport robot for transport of construction materials	0.00029641	2008
$Tc_{119}A_{34}$	s_{39}	0.2289	cc_{79}	0.0256	A_{34}	0.0413	Anti-swinging input shaping control of an automatic construction crane	0.02423998	2008
$Tc_{198}A_{56}$	s_6	0.0846	cc_{79}	0.0256	A_{56}	0.0688	Improved force feedback control method for construction telerobot	0.01493042	2008
$Tc_{86}A_{56}$		0.0050	cc_{86}	0.0385	A_{56}	0.0688	Construction telerobot system with virtual reality (development of a bilateral construction robot)	0.00131739	2008

$Tc_{149}A_{50}$	s_{89}	0.0050	cc_{90}	0.0256	A_{50}	0.0516	Development of an automated verticality alignment system for a vibro-lance	0.00065870	2008
$Tc_{71}A_{22}$	s_{18}	0.0100	cc_{105}	0.0096	A_{22}	0.0534	Feasibility verification of brick-laying robot using manipulation trajectory and the laying pattern optimization	0.00051049	2009
$Tc_{91}A_{29}$	s_{113}	0.0050	cc_{111}	0.0032	A_{29}	0.0310	A laser-technology-based lifting-path tracking system for a robotic tower crane	0.00004940	2009
$Tc_{192}A_{56}$	s_{134}	0.0050	cc_{113}	0.0128	A_{56}	0.0688	Haptic interaction in tele-operation control system of construction robot based on virtual reality	0.00043913	2009
$Tc_{104}A_{32}$	s_{14}	0.0697	cc_{25}	0.0064	A_{32}	0.0310	Light-weight 3D LADAR system for construction robotic operations	0.00138326	2009
$Tc_{167}A_{54}$	s_{14}	0.0697	cc_{32}	0.0096	A_{54}	0.0379	Simulation of industrial robots for laser welding of load bearing construction	0.00253598	2009
$Tc_{186}A_{56}$	s_{133}	0.0050	cc_{36}	0.0192	A_{56}	0.0688	Tele-operation construction robot control system with virtual reality	0.00065870	2009
$Tc_{128}A_{41}$	s_{81}	0.0100	cc_{59}	0.0032	A_{41}	0.0138	Work state identification using primitive static states - Implementation to demolition work in double-front work machines	0.00004391	2009
$Tc_{209}A_{6}$	s_{104}	0.0050	cc_{73}	0.1282	A_{6}	0.0723	Bridge inspection robot system with machine vision	0.00461087	2009
$Tc_{190}A_{56}$	s_{135}	0.0050	cc_{26}	0.0256	A_{56}	0.0688	Virtual reality-based teleoperation construction robot control system with 3D visor device	0.00087826	2010
$Tc_{160}A_{50}$		0.0050	cc_{45}	0.0096	A_{50}	0.0516	Specific mechanisms for construction mobile robots	0.00024701	2010
$Tc_{162}A_{50}$	s_{57}	0.0050	cc_{79}	0.0256	A_{50}	0.0516	Labview based control and simulation of a construction robot	0.00065870	2010
$Tc_{198}A_{56}$	s_{6}	0.0846	cc_{79}	0.0256	A_{56}	0.0688	Research on improved force feedback control method for construction telerobot	0.01493042	2010
$Tc_{199}A_{56}$	s_{39}	0.2289	cc_{80}	0.0096	A_{56}	0.0688	Development of immersive augmented reality interface system for construction robotic system	0.01514999	2010
$Tc_{196}A_{50}$	s_{6}	0.0846	cc_{84}	0.0064	A_{50}	0.0516	Bilateral hydraulic servo control system based on force sense for construction robot	0.00279945	2010
$Tc_{201}A_{50}$	s_{6}	0.0846	cc_{86}	0.0385	A_{50}	0.0516	Research on bilateral hydraulic servo control system of construction robotics	0.01679673	2010

$Tc_{86}A_{56}$		0.0050	cc_{86}	0.0385	A_{56}	0.0688	Study on master-slave control method using load force and impedance identifiers for Tele-operated hydraulic construction robot	0.00131739	2010
$Tc_{214}A_{6}$		0.0050	cc_{104}	0.0032	A_{6}	0.0723	Robot-aided tunnel inspection and maintenance system	0.00011527	2011
$Tc_{211}A_{6}$	s_{109}	0.0199	cc_{107}	0.0032	A_{6}	0.0723	Strateg+D171 Autonomous robots to inspect pavement distresses	0.00046109	2011
$Tc_{49}A_{17}$	s_{157}	0.0050	cc_{112}	0.0096	A_{17}	0.0103	A conceptualization for the automation of a lift car operation in high rise building construction	0.00004940	2011
$Tc_{164}A_{50}$		0.0050	cc_{114}	0.0128	A_{50}	0.0516	LTL-based decentralized supervisory control of multi-robot tasks modelled as Petri nets	0.00032935	2011
$Tc_{20}A_{11}$		0.0050	cc_{28}	0.0032	A_{11}	0.0551	Concept of a wall building industrial robotic system	0.00008783	2011
$Tc_{24}A_{40}$	s_{8}	0.0199	cc_{38}	0.0064	A_{40}	0.0034	Development of pressure observer to measure cylinder length of harbor-construction robot	0.00004391	2011
$Tc_{155}A_{52}$	s_{108}	0.0050	cc_{62}	0.0224	A_{52}	0.0103	Study on a vision sensing system for the parameter estimation of a serial construction robot	0.00011527	2011
$Tc_{94}A_{30}$	s_{109}	0.0199	cc_{62}	0.0224	A_{30}	0.0103	A plan for lunar outpost construction by using robots	0.00046109	2011
$Tc_{25}A_{9}$	s_{39}	0.2289	cc_{115}	0.0224	A_{9}	0.0069	Tunnel boring machine positioning automation in tunnel construction	0.00353500	2012
$Tc_{13}A_{38}$		0.0050	cc_{115}	0.0224	A_{38}	0.0155	High accuracy position marking system applying mobile robot in construction site	0.00017291	2012
$Tc_{13}A_{54}$		0.0050	cc_{115}	0.0224	A_{54}	0.0379	Automatic welding robot system for the horizontal position in the shipyard	0.00042266	2012
$Tc_{125}A_{38}$		0.0050	cc_{119}	0.0032	A_{38}	0.0155	Development of high accuracy position marking system in construction site applying automated mark robot	0.00002470	2012
$Tc_{165}A_{54}$	s_{16}	0.0050	cc_{19}	0.0032	A_{54}	0.0379	Model analysis and experimental technique on computing accuracy of seam spatial position information based on stereo vision for welding robot	0.00006038	2012
$Tc_{189}A_{56}$		0.0050	cc_{26}	0.0256	A_{56}	0.0688	Autonomous task control system of construction tele-robot based on stereo vision	0.00087826	2012
$Tc_{10}A_{11}$	s_{25}	0.0050	cc_{29}	0.0032	A_{11}	0.0551	Autonomous Construction of a Roofed Structure: Synthesizing Planning and Stigmergy on a Mobile Robot	0.00008783	2012

$Tc_{68}A_{22}$	s_{72}	0.0050	cc_{3}	0.0064	A_{22}	0.0534	Development of refractory brick construction robot in steel works	0.00017016	2012
$Tc_{184}A_{56}$		0.0050	cc_{62}	0.0224	A_{56}	0.0688	Research on ROI image processing technology of teleoperation construction robot based on trinocular stereo vision	0.00076848	2012
$Tc_{48}A_{17}$	$s_{11}9$	0.0050	cc_{67}	0.0064	A_{17}	0.0103	Sensor Based Motion Planning and Estimation of High-rise Building Facade Maintenance Robot	0.00003293	2012
$Tc_{100}A_{32}$	s_{14}	0.0697	cc_{73}	0.1282	A_{32}	0.0310	Study on 3-D laser-scanning-based machine vision system for robotic construction vehicles	0.02766520	2012
$Tc_{191}A_{56}$		0.0050	cc_{84}	0.0064	A_{56}	0.0688	Force feedback control of tele-operated construction robot based on regression model	0.00021957	2012
$Tc_{86}A_{25}$		0.0050	cc_{86}	0.0385	A_{25}	0.0069	Application of a position-force control method in a master-slave teleoperation construction robot system	0.00013174	2012
$Tc_{86}A_{25}$		0.0050	cc_{86}	0.0385	A_{25}	0.0069	Operability of a control method for grasping soft objects in a construction teleoperation robot tested in virtual reality	0.00013174	2012
$Tc_{86}A_{25}$		0.0050	cc_{86}	0.0385	A_{25}	0.0069	Master-slave control method with force feedback for grasping soft objects using a teleoperation construction robot	0.00013174	2012
$Tc_{35}A_{12}$	s_{14}	0.0697	cc_{90}	0.0256	A_{12}	0.0241	Human-robot-environment interaction interface for robotic grit-blasting of complex steel bridges	0.00430347	2012
$Tc_{84}A_{29}$		0.0050	cc_{10}	0.0096	A_{29}	0.0310	Autonomous robotic dozing for rapid material removal	0.00014821	2013
$Tc_{109}A_{32}$		0.0050	cc_{112}	0.0096	A_{32}	0.0310	Human-robot integration for pose estimation and semi-autonomous navigation on unstructured construction sites	0.00014821	2013
$Tc_{53}A_{19}$	s_{54}	0.1393	cc_{116}	0.0032	A_{19}	0.0138	A novel surface segmentation approach for robotic manipulator-based maintenance operation planning	0.00061478	2013
$Tc_{18}A_{11}$	s_{26}	0.0050	cc_{30}	0.0032	A_{11}	0.0551	Development of fail-safety system for building wall cleaning robot	0.00008783	2013
$Tc_{157}A_{50}$		0.0050	cc_{37}	0.0032	A_{50}	0.0516	Mutli-robot distributed control for construction tasks based on intelligent beacons	0.00008234	2013
$Tc_{62}A_{20}$	s_{37}	0.0050	cc_{40}	0.0032	A_{20}	0.0138	Autonomous thin spray-on liner application in irregular tunnel and mine roadway surfaces	0.00002196	2013

$Tc_{33}A_{24}$		0.0050	cc_{49}	0.0160	A_{24}	0.0224	Path planning of wheel loader type robot for scooping and loading operation by genetic algorithm	0.00017840	2013
$Tc_{87}A_{37}$	s_8	0.0199	cc_5	0.0160	A_{37}	0.0155	Potentials of robotic fabrication in wood construction: Elastically bent timber sheets with robotically fabricated finger joints	0.00049402	2013
$Tc_{96}A_{31}$		0.0050	cc_{54}	0.0032	A_{31}	0.0069	Design and research of a construction robot based on series parallel structure	0.00001098	2013
$Tc_{27}A_{56}$		0.0050	cc_{90}	0.0256	A_{56}	0.0688	Geometric and kinematics modeling of tele-operated virtual construction robot	0.00087826	2013
$Tc_{114}A_{34}$	s_{54}	0.1393	cc_{95}	0.0096	A_{34}	0.0413	An implementation of a teleoperation system for robotic beam assembly in construction	0.00553304	2013
$Tc_{34}A_{29}$	s_{39}	0.2289	cc_{112}	0.0096	A_{29}	0.0310	Potential of Time-of-Flight Range Imaging for Object Identification and Manipulation in Construction	0.00681749	2014
$Tc_{156}A_{50}$	s_{39}	0.2289	cc_{26}	0.0256	A_{50}	0.0516	Chip-based real-time gesture tracking for construction robot's guidance	0.03029998	2014
$Tc_{160}A_{50}$		0.0050	cc_{45}	0.0096	A_{50}	0.0516	Modified discrete event simulation algorithm for control of automated construction operations	0.00024701	2014
$Tc_{160}A_{50}$		0.0050	cc_{45}	0.0096	A_{50}	0.0516	Automating construction operations using discrete event simulation models (control simulation design)	0.00024701	2014
$Tc_{58}A_{2}$	s_{64}	0.0050	cc_{60}	0.0032	A_{2}	0.0086	Robotic tile placement: Tools, techniques and feasibility	0.00001372	2014
$Tc_{185}A_{56}$	s_{136}	0.0100	cc_{62}	0.0224	A_{56}	0.0688	Development of a teleoperation system for a construction robot	0.00153696	2014
$Tc_{66}A_{21}$	s_{39}	0.2289	cc_{62}	0.0224	A_{21}	0.0172	Automatic detection and verification of pipeline construction features with multi-modal data	0.00883749	2014
$Tc_{21}A_{34}$		0.0050	cc_{75}	0.0545	A_{34}	0.0413	Development of a BIM-based automated construction system	0.00111978	2014
$Tc_{228}A_{8}$	s_{92}	0.0050	cc_{92}	0.0064	A_{8}	0.0293	Virtual prototyping for robotic fabrication of rebar cages in manufactured concrete construction	0.00009332	2014
$Tc_{30}A_{12}$	s_{39}	0.2289	cc_{98}	0.0064	A_{12}	0.0241	Rapid and automated determination of rusted surface areas of a steel bridge for robotic maintenance systems	0.00353500	2014
$Tc_{113}A_{34}$		0.0050	cc_{98}	0.0064	A_{34}	0.0413	A Tree-Based Algorithm for Construction Robots	0.00013174	2014

$Tc_{67}A_{21}$		0.0050	cc_{101}	0.0032	A_{21}	0.0172	Modeling and control of automated pipe hoisting in oil and gas well construction	0.00002745	2015
$Tc_{111}A_{32}$	s_{143}	0.0050	cc_{105}	0.0096	A_{32}	0.0310	Construction site navigation for the autonomous excavator Thor	0.00014821	2015
$Tc_{40}A_{14}$	s_{127}	0.0100	cc_{113}	0.0128	A_{14}	0.0138	Position reaction force control of teleoperation construction robot for grasping soft objects	0.00017565	2015
$Tc_{158}A_{52}$	s_{6}	0.0846	cc_{113}	0.0128	A_{52}	0.0103	Automated measurement and estimation of concrete strength by mobile robot with small-sized grinding drill	0.00111978	2015
$Tc_{108}A_{34}$	s_{54}	0.1393	cc_{118}	0.0417	A_{34}	0.0413	Vision guided autonomous robotic assembly and as-built scanning on unstructured construction sites	0.02397650	2015
$Tc_{135}A_{54}$	s_{39}	0.2289	cc_{20}	0.0064	A_{54}	0.0379	Intuitive task programming of stud welding robots for ship construction	0.00555500	2015
$Tc_{61}A_{20}$	s_{39}	0.2289	cc_{41}	0.0032	A_{20}	0.0138	Automatic path-planning algorithm for realistic decorative robotic painting	0.00101000	2015
$Tc_{85}A_{25}$		0.0050	cc_{50}	0.0064	A_{25}	0.0069	Design and construction of a translational parallel robot for drilling tasks	0.00002196	2015
$Tc_{21}A_{22}$		0.0050	cc_{75}	0.0545	A_{22}	0.0534	Towards a new BIM 'dimension'-translating BIM data into actual construction using robotics	0.00144638	2015
$Tc_{199}A_{56}$	s_{39}	0.2289	cc_{80}	0.0096	A_{56}	0.0688	Augmented reality-based tele-robotic system architecture for on-site construction	0.01514999	2015
$Tc_{202}A_{56}$	s_{136}	0.0100	cc_{86}	0.0385	A_{56}	0.0688	Development of a telerobotics system for construction robot using virtual reality	0.00263478	2015
$Tc_{136}A_{14}$	s_{126}	0.0050	cc_{108}	0.0032	A_{14}	0.0138	Robotic SHM and Model-Based Positioning System for Monitoring and Construction Automation	0.00002196	2016
$Tc_{177}A_{56}$	s_{6}	0.0846	cc_{20}	0.0064	A_{56}	0.0688	Estimation for torques applied to the master side in a construction robot teleoperation system	0.00373261	2016
$Tc_{122}A_{54}$		0.0050	cc_{21}	0.0032	A_{54}	0.0379	Research on Improving the Efficiency and Welding Quality of Welding Robot for Construction Machinery Structure	0.00006038	2016
$Tc_{180}A_{55}$		0.0050	cc_{3}	0.0064	A_{55}	0.0275	Parameter study of chain trenching machines of Underwater Construction Robots via analytical model	0.00008783	2016
$Tc_{45}A_{18}$	s_{39}	0.2289	cc_{44}	0.0417	A_{18}	0.0069	Robotic 3D-printing for building and construction	0.00656499	2016

$Tc_{148}A_{29}$	s_{85}	0.0050	cc_{73}	0.1282	A_{29}	0.0310	Machine Learning approach to Automatic Bucket Loading	0.00197609	2016
$Tc_{76}A_{34}$		0.0050	cc_{73}	0.1282	A_{34}	0.0413	Site Automation: Automated/Robotic On-Site Factories	0.00263478	2016
$Tc_{21}A_{22}$		0.0050	cc_{75}	0.0545	A_{22}	0.0534	Simulation of automated construction using wire robots	0.00144638	2016
$Tc_{195}A_{56}$		0.0050	cc_{78}	0.0032	A_{56}	0.0688	Support system for slope shaping based on a teleoperated construction robot	0.00010978	2016
$Tc_{203}A_{56}$	s_{39}	0.2289	cc_{86}	0.0385	A_{56}	0.0688	Support system for teleoperation of slope shaping by a construction robot	0.06059995	2016
$Tc_{218}A_{61}$		0.0050	cc_{9}	0.0064	A_{61}	0.0034	A realisation of a construction scale robotic system for 3D printing of complex formwork	0.00001098	2016
$Tc_{28}A_{12}$	s_{96}	0.0050	cc_{99}	0.0032	A_{12}	0.0241	Smart automation system dedicated to in frastructure and construction	0.00003842	2016
$Tc_{83}A_{24}$	s_{39}	0.2289	cc_{105}	0.0096	A_{24}	0.0224	A cable-driven robot for architectural constructions: a visual-guided approach for motion control and path-planning	0.00492375	2017
$Tc_{110}A_{32}$	s_{14}	0.0697	cc_{110}	0.0160	A_{32}	0.0310	Automatic interpretation of unordered point cloud data for UAV navigation in construction	0.00345815	2017
$Tc_{234}A_{52}$	s_{6}	0.0846	cc_{114}	0.0128	A_{52}	0.0103	Using local force measurements to guide construction by distributed climbing robots	0.00111978	2017
$Tc_{16}A_{58}$		0.0050	cc_{32}	0.0096	A_{58}	0.0069	Robotic system for plaster and finishing works on the construction site	0.00003293	2017
$Tc_{238}A_{55}$		0.0050	cc_{4}	0.0032	A_{55}	0.0275	Development of a remotely controlled semi-underwater heavy carrier robot for unmanned construction works	0.00004391	2017
$Tc_{44}A_{16}$		0.0050	cc44	0.0417	A_{16}	0.0189	SMCSPO based 3D printing simulator control for building construction	0.00039247	2017
$Tc_{44}A_{16}$		0.0050	cc_{44}	0.0417	A_{16}	0.0189	Development of 3D printing simulator nozzle system using PID control for building construction	0.00039247	2017
$Tc_{44}A_{16}$		0.0050	cc_{44}	0.0417	A_{16}	0.0189	Automation of robotic concrete printing using feedback control system	0.00039247	2017
$Tc_{44}A_{16}$		0.0050	cc_{44}	0.0417	A_{16}	0.0189	Classification of building systems for concrete 3D printing	0.00039247	2017
$Tc_{87}A_{55}$	s_{8}	0.0199	cc_{5}	0.0160	A_{55}	0.0275	Active control for rock grinding works of an underwater construction robot consisting of hydraulic rotary and linear actuators	0.00087826	2017

$Tc_{217}A_{60}$		0.0050	cc_{57}	0.0032	A_{60}	0.0086	A method based on C-K Theory for fast STCR development: The case of a drilling robot design	0.00001372	2017
$Tc_{176}A_{55}$	s_6	0.0846	cc_6	0.0032	A_{55}	0.0275	Development of the control algorithm for longitudinal motion of Underwater Construction Robot with trenching	0.00074652	2017
$Tc_{77}A_{22}$		0.0050	cc_{72}	0.0032	A_{22}	0.0534	A Stochastic Learning Approach for Construction of Brick Structures with a Ground Robot	0.00008508	2017
$Tc_{223}A_{50}$	s_{43}	0.0050	cc_{73}	0.1282	A_{50}	0.0516	Online Learning Control of Hydraulic Excavators Based on Echo-State Networks	0.00329348	2017
$Tc_{73}A_8$	s_{14}	0.0697	cc_{75}	0.0545	A_8	0.0293	Beam for the steel fabrication industry robotic systems	0.01110450	2017
$Tc_{21}A_3$		0.0050	cc_{75}	0.0545	A_3	0.0069	Model-based development of robotic systems and services in construction robotics	0.00018663	2017
$Tc_{120}A_{34}$	s_{127}	0.0100	cc_{82}	0.0192	A_{34}	0.0413	Scene understanding for adaptive manipulation in robotized construction work	0.00079043	2017
$Tc_{204}A_{56}$	s_{137}	0.0050	cc_{86}	0.0385	A_{56}	0.0688	A master-slave control method with gravity compensation for a hydraulic teleoperation construction robot	0.00131739	2017
$Tc_{27}A_{34}$		0.0050	cc_{90}	0.0256	A_{34}	0.0413	Robotic fabrication of freeform foam structures with quadrilateral and puzzle shaped panels	0.00052696	2017
$Tc_{221}A_{62}$	s_{39}	0.2289	cc_{94}	0.0032	A_{62}	0.0017	PyroShield - A HVAC fire curtain testing robot	0.00012625	2017
$Tc_{98}A_{32}$	s_{82}	0.0050	cc_{96}	0.0096	A_{32}	0.0310	Target-Focused Local Workspace Modeling for Construction Automation Applications	0.00014821	2017
$Tc_{99}A_{32}$	s_{109}	0.0199	cc_{103}	0.0224	A_{32}	0.0310	Automated localization of UAVs in GPS-denied indoor construction environments using fiducial markers	0.00138326	2018
$Tc_{84}A_{24}$		0.0050	cc_{103}	0.0224	A_{24}	0.0224	Construction equipment collision-free path planning using robotic approach	0.00024976	2018
$Tc_{84}A_{33}$		0.0050	cc_{103}	0.0224	A_{33}	0.0069	A robotic wearable exoskeleton for construction worker's safety and health	0.00007685	2018
$Tc_{84}A_{45}$		0.0050	cc_{103}	0.0224	A_{45}	0.0241	Identification of usage scenarios for robotic exoskeletons in the context of the Hong Kong construction industry	0.00026897	2018
$Tc_{142}A_{46}$	s_{14}	0.0697	cc_{110}	0.0160	A_{46}	0.0052	Mapping and localization module in a mobile robot for insulating building crawl spaces	0.00057636	2018
$Tc_{174}A_{55}$		0.0050	cc_{113}	0.0128	A_{55}	0.0275	Study on down-cutting ladder trencher of an underwater construction robot for seabed application	0.00017565	2018

$Tc_{107}A_{32}$	s_{29}	0.0149	cc_{118}	0.0417	A_{32}	0.0310	SLAM-driven intelligent autonomous mobile robot navigation for construction applications	0.00192668	2018
$Tc_{38}A_{32}$	s_{39}	0.2289	cc_{118}	0.0417	A_{32}	0.0310	Building an integrated mobile robotic system for real-time applications in construction	0.02954248	2018
$Tc_{38}A_{32}$	s_{39}	0.2289	cc_{118}	0.0417	A_{32}	0.0310	Vision-based integrated mobile robotic system for real-time applications in construction	0.02954248	2018
$Tc_{233}A_{43}$	s_{6}	0.0846	cc_{17}	0.0032	A_{43}	0.0086	Implementation of Admittance Control on a Construction Robot Using Load Cells	0.00023329	2018
$Tc_{17}A_{11}$	s_{28}	0.0050	cc_{31}	0.0160	A_{11}	0.0551	The study on the integrated control system for curtain wall building façade cleaning robot	0.00043913	2018
$Tc_{225}A_{7}$	s_{48}	0.0199	cc_{31}	0.0160	A_{7}	0.0207	Modular data communication methods for a robotic excavator	0.00065870	2018
$Tc_{45}A_{18}$	s_{39}	0.2289	cc_{44}	0.0417	A_{18}	0.0069	Large-scale 3D printing by a team of mobile robots	0.00656499	2018
$Tc_{50}A_{18}$	s_{48}	0.0199	cc_{44}	0.0417	A_{18}	0.0069	MAP - A Mobile Agile Printer Robot for on-site Construction	0.00057087	2018
$Tc_{178}A_{55}$	s_{6}	0.0846	cc_{5}	0.0160	A_{55}	0.0275	Active control strategy for trenching work of track-based underwater construction robot	0.00373261	2018
$Tc_{103}A_{32}$	s_{109}	0.0199	cc73	0.1282	A_{32}	0.0310	The Autonomous Vehicle CELiNA as Educational Platform on Final Works in Computer Science	0.00790434	2018
$Tc_{150}A_{50}$	s_{146}	0.0050	cc_{73}	0.1282	A_{50}	0.0516	Real-time simulation of construction workers using combined human body and hand tracking for robotic construction worker system	0.00329348	2018
$Tc_{127}A_{39}$	s_{158}	0.0050	cc_{73}	0.1282	A_{39}	0.0017	Multimodal Trip Hazard Affordance Detection on Construction Sites	0.00010978	2018
$Tc_{32}A_{51}$	s_{39}	0.2289	cc_{73}	0.1282	A_{51}	0.0052	Stacked hourglass networks for markerless pose estimation of articulated construction robots	0.01514999	2018
$Tc_{32}A_{59}$	s_{39}	0.2289	cc_{73}	0.1282	A_{59}	0.0069	Industrial Robot Control with Object Recognition based on Deep Learning	0.02019998	2018
$Tc_{32}A_{6}$	s_{39}	0.2289	cc_{73}	0.1282	A_{6}	0.0723	Automated defect classification in sewer closed circuit television inspections using deep convolutional neural networks	0.21209983	2018

$Tc_{76}A_{36}$		0.0050	cc_{73}	0.1282	A_{36}	0.0086	Synthesis of the AC and DC Drives Fault Diagnosis Method for the Cyber-physical Systems of Building Robots	0.00054891	2018
$Tc_{76}A_{36}$		0.0050	cc_{73}	0.1282	A_{36}	0.0086	A cyber-physical system of diagnosing electric drives of building robots	0.00054891	2018
$Tc_{73}A_{22}$	s_{14}	0.0697	cc_{75}	0.0545	A_{22}	0.0534	Concept studies of automated construction using cable-driven parallel robots	0.02024939	2018
$Tc_{37}A_{13}$	s_{29}	0.0149	cc_{75}	0.0545	A_{13}	0.0034	Design of Robot based Work Progress Monitoring System for the Building Construction Site	0.00027995	2018
$Tc_{21}A_{15}$		0.0050	cc_{75}	0.0545	A_{15}	0.0086	BIM plus Robot Creates a New Era of Building Construction	0.00023329	2018
$Tc_{21}A_{15}$		0.0050	cc_{75}	0.0545	A_{15}	0.0086	UAV-Enabled Site-to-BIM Automation: Aerial Robotic- and Computer Vision-Based Development of As-Built/As-Is BIMs and Quality Control	0.00023329	2018
$Tc_{21}A_{63}$		0.0050	cc_{75}	0.0545	A_{63}	0.0086	Perspectives on a BIM-integrated software platform for robotic construction through Contour Crafting	0.00023329	2018
$Tc_{21}A_{9}$		0.0050	cc_{75}	0.0545	A_{9}	0.0069	Information modeling of an underground laboratory for the R&D of mining automation and tunnel construction robotics	0.00018663	2018
$Tc_{198}A_{55}$	s_{6}	0.0846	cc_{79}	0.0256	A_{55}	0.0275	Dynamics modeling and structural analysis of underwater construction robot	0.00597217	2018
$Tc_{12}A_{43}$	s_{129}	0.0100	cc_{82}	0.0192	A_{43}	0.0086	Workpiece Modeling for Adaptive Robotized Construction Work	0.00016467	2018
$Tc_{12}A_{43}$	s_{129}	0.0100	cc_{82}	0.0192	A_{43}	0.0086	Adaptive perception and modeling for robotized construction joint filling	0.00016467	2018
$Tc_{69}A_{22}$		0.0050	cc_{82}	0.0192	A_{22}	0.0534	Enhancing perceived safety in human-robot collaborative construction using immersive virtual environments	0.00051049	2018
$Tc_{203}A_{56}$	s_{39}	0.2289	cc_{86}	0.0385	A_{56}	0.0688	Teleoperated construction robot using visual support with drones	0.06059995	2018
$Tc_{86}A_{34}$		0.0050	cc_{86}	0.0385	A_{34}	0.0413	FOAM Custom Single Task Construction Robot	0.00079043	2018
$Tc_{173}A_{55}$	s_{6}	0.0846	cc_{9}	0.0064	A_{55}	0.0275	A propulsion performance test of underwater construction robot light work ROV uri-L in circulation water channel	0.00149304	2018

$Tc_{212}A_6$	s_{54}	0.1393	cc_{106}	0.0032	A_6	0.0723	Construction and usage of three-dimensional data for road structures using terrestrial laser scanning and UAV with photo grammetry	0.00322761	2019
$Tc_{131}A_{36}$	s_{39}	0.2289	cc_{110}	0.0160	A_{36}	0.0086	Framework for automated registration of UAV and UGV point clouds using local features in images	0.00315625	2019
Tc_9A_{11}	s_{29}	0.0149	cc_{118}	0.0417	A_{11}	0.0551	Monocular Vision-Based Parameter Estimation for Mobile Robotic Painting	0.00342521	2019
$Tc_{123}A_{24}$	s_{48}	0.0199	cc_{118}	0.0417	A_{24}	0.0224	Implementation of an augmented reality AR workflow for human robot collaboration in timber prefabrication	0.00185532	2019
$Tc_{108}A_{24}$	s_{54}	0.1393	cc_{118}	0.0417	A_{24}	0.0224	An Occupancy Grid Mapping enhanced visual SLAM for real-time locating applications in indoor GPS-denied environments	0.01298727	2019
$Tc_{139}A_{54}$	s_{19}	0.0100	cc_{22}	0.0064	A_{54}	0.0379	Collaborative Welding System using BIM for Robotic Reprogramming and Spatial Augmented Reality	0.00024152	2019
$Tc_{133}A_{33}$	s_{39}	0.2289	cc_{22}	0.0064	A_{33}	0.0069	Towards mobile projective AR for construction co-robots	0.00101000	2019
$Tc_{159}A_{54}$		0.0050	cc_{23}	0.0032	A_{54}	0.0379	Construction of the Remote Welding System based on Power Line Communication	0.00006038	2019
$Tc_{14}A_{11}$	s_{31}	0.0050	cc_{34}	0.0032	A_{11}	0.0551	Man-machine Cooperation of Building Robot Based on Interactive Force Information	0.00008783	2019
$Tc_{44}A_{11}$		0.0050	cc_{44}	0.0417	A_{11}	0.0551	3D printing for construction based on a complex wall of polymer-foam and concrete	0.00114174	2019
$Tc_{44}A_{18}$		0.0050	cc_{44}	0.0417	A_{18}	0.0069	Large-scale digital concrete construction – CONPrint3D concept for on-site, monolithic 3D-printing	0.00014272	2019
$Tc_{60}A_2$	s_{14}	0.0697	cc_{46}	0.0128	A_2	0.0086	Measuring and positioning system design of robotic floor-tiling	0.00076848	2019
$Tc_{60}A_{29}$	s_{14}	0.0697	cc_{46}	0.0128	A_{29}	0.0310	Tip Localization Analysis for Mobile Manipulator in Construction Field	0.00276652	2019
$Tc_{90}A_{29}$	s_{39}	0.2289	cc_{58}	0.0032	A_{29}	0.0310	Soft Additive Fabrication Processes: Material Indeterminacy in 3D Printing	0.00227250	2019
$Tc_{102}A_{32}$	s_{39}	0.2289	cc_{66}	0.0032	A_{32}	0.0310	Vision-Based Obstacle Removal System for Autonomous Ground Vehicles Using a Robotic Arm	0.00227250	2019

$Tc_{32}A_{15}$	s_{39}	0.2289	cc_{73}	0.1282	A_{15}	0.0086	Computer vision for real-time extrusion quality monitoring and control in robotic construction	0.02524998	2019
$Tc_{32}A_{32}$	s_{39}	0.2289	cc_{73}	0.1282	A_{32}	0.0310	Real-Time Scene Segmentation Using a Light Deep Neural Network Architecture for Autonomous Robot Navigation on Construction Sites	0.09089993	2019
$Tc_{32}A_{32}$	s_{39}	0.2289	cc_{73}	0.1282	A_{32}	0.0310	LNSNet: Lightweight navigable space segmentation for autonomous robots on construction sites	0.09089993	2019
$Tc_{32}A_{50}$	s_{39}	0.2289	cc_{73}	0.1282	A_{50}	0.0516	Vision-based estimation of excavator manipulator pose for automated grading control	0.15149988	2019
$Tc_{32}A_{51}$	s_{39}	0.2289	cc_{73}	0.1282	A_{51}	0.0052	A vision-based marker-less pose estimation system for articulated construction robots	0.01514999	2019
$Tc_{4}A_{50}$	s_{6}	0.0846	cc_{73}	0.1282	A_{50}	0.0516	Analytical design of an underwater construction robot on the slope with an up-cutting mode operation of a cutter bar	0.05598909	2019
$Tc_{76}A_{22}$		0.0050	cc_{73}	0.1282	A_{22}	0.0534	Automated Brick Pattern Generator for Robotic Assembly using Machine Learning and Images	0.00340326	2019
$Tc_{76}A_{28}$		0.0050	cc_{73}	0.1282	A_{28}	0.0189	Teaching robots to perform construction tasks via learning from demonstration	0.00120761	2019
$Tc_{76}A_{33}$		0.0050	cc_{73}	0.1282	A_{33}	0.0069	Semantic Relation Detection between Construction Entities to Support Safe Human-Robot Collaboration in Construction	0.00043913	2019
$Tc_{76}A_{36}$		0.0050	cc_{73}	0.1282	A_{36}	0.0086	Formulation of the optimization problem of the cyber-physical diagnosis system configuration level for construction mobile robots	0.00054891	2019
$Tc_{206}A_{58}$	s_{19}	0.0100	cc_{75}	0.0545	A_{58}	0.0069	Automatical acquisition of point clouds of construction sites and its application in autonomous interior finishing robot	0.00037326	2019
$Tc_{92}A_{30}$	s_{54}	0.1393	cc_{75}	0.0545	A_{30}	0.0103	Robotic construction & Prototyping of a 3D-printed Mars surface habitat	0.00783847	2019
$Tc_{92}A_{38}$	s_{54}	0.1393	cc_{75}	0.0545	A_{38}	0.0155	An Automated System for Projection of Interior Construction Layouts	0.01175771	2019

$Tc_{21}A_{37}$		0.0050	cc_{75}	0.0545	A_{37}	0.0155	Game Simulation to Support Construction Automation in Modular Construction Using BIM and Robotics Technology-Stage I	0.00041992	2019
$Tc_{193}A_{56}$	s_{140}	0.0050	cc_{77}	0.0032	A_{56}	0.0688	Flexible virtual fixtures for human-excavator cooperative system	0.00010978	2019
$Tc_{163}A_{50}$	s_{84}	0.0149	cc_{79}	0.0256	A_{50}	0.0516	YouWasps: Towards Autonomous Multi-Robot Mobile Deposition for Construction	0.00197609	2019
$Tc_{69}A_{43}$	s_{54}	0.1393	cc_{82}	0.0192	A_{43}	0.0086	Planning and Execution for Geometrically Adaptive BIM-Driven Robotized Construction Processes	0.00230543	2019
$Tc_{69}A_{43}$	s_{54}	0.1393	cc_{82}	0.0192	A_{43}	0.0086	Autonomous motion planning and task execution in geometrically adaptive robotized construction work	0.00230543	2019
$Tc_{235}A_{50}$		0.0050	cc_{83}	0.0032	A_{50}	0.0516	Dynamic analysis of high precision construction cable-driven parallel robots	0.00008234	2019
$Tc_{146}A_{5}$	s_{84}	0.0149	cc_{85}	0.0064	A_{5}	0.0120	Development of an earthmoving machinery autonomous excavator development platform	0.00011527	2019
$Tc_{146}A_{5}$	s_{84}	0.0149	cc_{85}	0.0064	A_{5}	0.0120	Robotic autonomous systems for earthmoving in military applications	0.00011527	2019
$Tc_{86}A_{16}$		0.0050	cc_{86}	0.0385	A_{16}	0.0189	Determinants of Adoption of Robotics in Precast Concrete Production for Buildings	0.00036228	2019
$Tc_{8}A_{10}$	s_{6}	0.0846	cc_{89}	0.0096	A_{10}	0.0138	Trajectory adaptation for an impedance controlled cooperative robot according to an operator's force	0.00111978	2019
$Tc_{208}A_{59}$	s_{54}	0.1393	cc_{110}	0.0160	A_{59}	0.0069	An autonomous robotic platform for automatic extraction of detailed semantic models of buildings	0.00153696	2020
$Tc_{213}A_{6}$	s_{79}	0.0100	cc_{110}	0.0160	A_{6}	0.0723	LiDAR-equipped UAV path planning considering potential locations of defects for bridge inspection	0.00115272	2020
$Tc_{101}A_{32}$	s_{144}	0.0149	cc_{118}	0.0417	A_{32}	0.0310	An integrated UGV-UAV system for construction site data collection	0.00192668	2020
$Tc_{101}A_{45}$	s_{144}	0.0149	cc_{118}	0.0417	A_{45}	0.0241	Construction of SLAM Algorithm for Window Cleaning Robot Moving Along Window Frame	0.00149853	2020
$Tc_{38}A_{46}$	s_{39}	0.2289	cc_{118}	0.0417	A_{46}	0.0052	A scene-adaptive descriptor for visual SLAM-based locating applications in built environments	0.00492375	2020

$Tc_{123}A_{11}$	s_{48}	0.0199	cc_{118}	0.0417	A_{11}	0.0551	Cooperative Aerial-Ground Multi-Robot System for Automated Construction Tasks (wall)	0.00456695	2020
$Tc_{36}A_{12}$	s_{79}	0.0100	cc_{118}	0.0417	A_{12}	0.0241	Automated Defect Quantification in Concrete Bridges Using Robotics and Deep Learning (bridge)	0.00099902	2020
$Tc_{39}A_{14}$		0.0050	cc_{118}	0.0417	A_{14}	0.0138	Development of construction robots using crazyflie	0.00028543	2020
$Tc_{16}A_{11}$		0.0050	cc_{32}	0.0096	A_{11}	0.0551	Robotic 3D clay printing of prefabricated non-conventional wall components based on a parametric-integrated design	0.00026348	2020
$Tc_{46}A_{16}$	s_{144}	0.0149	cc_{44}	0.0417	A_{16}	0.0189	Inspecting manufacturing precision of 3D printed concrete parts based on geometric dimensioning and tolerancing	0.00117742	2020
$Tc_{44}A_{16}$		0.0050	cc_{44}	0.0417	A_{16}	0.0189	Automation in the Construction of a 3D-Printed Concrete Wall with the Use of a Lintel Gripper	0.00039247	2020
$Tc_{44}A_{22}$		0.0050	cc_{44}	0.0417	A_{22}	0.0534	Bricklaying robot moving algorithms at a construction site	0.00110606	2020
$Tc_{44}A_{22}$		0.0050	cc_{44}	0.0417	A_{22}	0.0534	Additive manufacturing of cantilever - From masonry to concrete 3D printing	0.00110606	2020
$Tc_{33}A_{24}$		0.0050	cc_{49}	0.0160	A_{24}	0.0224	Generalized task allocation and route planning for robots with multiple depots in indoor building environments	0.00017840	2020
$Tc_{85}A_{50}$		0.0050	cc_{50}	0.0064	A_{50}	0.0516	The problem of manipulation and angular orientation of gripping devices of construction robots	0.00016467	2020
$Tc_{129}A_{41}$	s_{54}	0.1393	cc_{64}	0.0064	A_{41}	0.0138	Optimization of Grasping Efficiency of a Robot Used for Sorting Construction and Demolition Waste	0.00122956	2020
$Tc_{116}A_{34}$		0.0050	cc_{70}	0.0096	A_{34}	0.0413	Generic design aided robotically facade pick and place in construction site dataset	0.00019761	2020
$Tc_{188}A_{56}$	s_{139}	0.0100	cc_{73}	0.1282	A_{56}	0.0688	A General Approach for Automating Teleoperated Construction Machines	0.00878260	2020
$Tc_{188}A_{56}$	s_{139}	0.0100	cc_{73}	0.1282	A_{56}	0.0688	Direct-visual-operation support system for unmanned construction	0.00878260	2020
$Tc_{153}A_{50}$	s_{18}	0.0100	cc_{73}	0.1282	A_{50}	0.0516	Robot construction simulation using deep reinforcement learning+B21B4:B22B6B4:B20B4:B24BB4:B20	0.00658695	2020
$Tc_{32}A_{12}$	s_{39}	0.2289	cc_{73}	0.1282	A_{12}	0.0241	Measurement for cracks at the bottom of bridges based on tethered creeping unmanned aerial vehicle	0.07069994	2020

$Tc_{32}A_{24}$	s_{39}	0.2289	cc_{73}	0.1282	A_{24}	0.0224	Proximity Prediction of Mobile Objects to Prevent Contact-Driven Accidents in Co-Robotic Construction	0.06564995	2020
$Tc_{32}A_{37}$	s_{39}	0.2289	cc_{73}	0.1282	A_{37}	0.0155	Augmented drawn construction symbols: A method for ad hoc robotic fabrication	0.04544996	2020
$Tc_{130}A_{28}$	s_{54}	0.1393	cc_{73}	0.1282	A_{28}	0.0189	Teaching robots to perform quasi-repetitive construction tasks through human demonstration	0.03381302	2020
$Tc_{130}A_{41}$	s_{54}	0.1393	cc_{73}	0.1282	A_{41}	0.0138	Deep learning of grasping detection for a robot used in sorting construction and demolition waste	0.02459129	2020
$Tc_{130}A_{41}$	s_{54}	0.1393	cc_{73}	0.1282	A_{41}	0.0138	Vision-based robotic system for on-site construction and demolition waste sorting and recycling	0.02459129	2020
$Tc_{75}A_{16}$		0.0050	cc_{73}	0.1282	A_{16}	0.0189	Structural stay-in-place formwork for robotic in situ fabrication of non-standard concrete structures: A real scale architectural demonstrator	0.00120761	2020
$Tc_{76}A_{24}$		0.0050	cc_{73}	0.1282	A_{24}	0.0224	Complete coverage path planning using reinforcement learning for Tetromino based cleaning and maintenance robot	0.00142717	2020
$Tc_{76}A_{29}$		0.0050	cc_{73}	0.1282	A_{29}	0.0310	What lies beneath: Material classification for autonomous excavators using proprioceptive force sensing and machine learning	0.00197609	2020
$Tc_{33}A_{8}$		0.0050	cc_{73}	0.1282	A_{8}	0.0293	Agent based modeling to optimize workflow of robotic steel and concrete 3D printers	0.00186630	2020
$Tc_{143}A_{48}$	s_{17}	0.0050	cc_{75}	0.0545	A_{48}	0.0034	Combining the Robot Operating System with Building Information Modeling for Robotic Applications in Construction Logistics	0.00009332	2020
$Tc_{74}A_{22}$	s_{39}	0.2289	cc_{75}	0.0545	A_{22}	0.0534	BIM-based task-level planning for robotic brick assembly through image-based 3D modeling	0.06653370	2020
$Tc_{227}A_{16}$		0.0050	cc_{93}	0.0032	A_{16}	0.0189	Bond properties of reinforcing bar penetrations in 3D concrete printing	0.00003019	2020
$Tc_{65}A_{21}$	s_{80}	0.0050	cc_{95}	0.0096	A_{21}	0.0172	Sampling robot for primary circuit pipelines of decommissioned nuclear facilities	0.00008234	2020
$Tc_{52}A_{19}$	s_{39}	0.2289	cc_{117}	0.0032	A_{19}	0.0138	Construction of land base station for uav maintenance automation	0.00101000	2021

$Tc_{63}A_{16}$	s_{39}	0.2289	cc_{39}	0.0032	A_{16}	0.0189	Robotic spray coating of self-sensing metakaolin geopolymer for concrete monitoring	0.00138875	2021

- occurrence probability of ThA_i related papers

Term labels	Subcategory labels								Papers (title)	Probability	Publication years
	a_i	P	b_i	P	ch_i	P	A_i	P			
$Th_{158}A_{55}$	a_6	0.0807	b_{52}	0.0441	ch_4	0.0041	A_{55}	0.0275	Development of a survey and inspection robot system for underwater construction works	0.000040	1974
Th_9A_{11}	a_4	0.0311	b_{15}	0.0132	ch_2	0.6585	A_{11}	0.0551	Blockbot: A robot to automate construction of cement block walls	0.001489	1988
$Th_{25}A_{54}$		0.5776	b_{67}	0.0573	ch_2	0.6585	A_{54}	0.0379	Using robots in the tubular structural constructions	0.082490	1988
$Th_{157}A_{50}$		0.5776	b_{52}	0.0441	ch_3	0.1707	A_{50}	0.0516	A concept of control system for construction robot	0.022433	1989
$Th_{35}A_{21}$	a_2	0.2236	b_2	0.1278	ch_6	0.0407	A_{21}	0.0172	Pipe manipulator enhancements for increased automation	0.001999	1989
$Th_{141}A_7$	a_4	0.0311	b_{12}	0.0573	ch_6	0.0407	A_7	0.0207	A master-slave manipulator for excavation and construction tasks	0.000149	1989
$Th_{35}A_7$	a_2	0.2236	b_2	0.1278	ch_6	0.0407	A_7	0.0207	Robots and automated systems for the civil and construction industries	0.002398	1990
$Th_{62}A_7$	a_2	0.2236	b_2	0.1278	ch_1	0.1260	A_7	0.0207	Air-force construction automation robotics	0.007435	1992
$Th_{156}A_6$	a_3	0.5776	b_{12}	0.0573	ch_1	0.1260	A_6	0.0723	A remotely operated building inspection cell	0.030135	1992
$Th_{123}A_{31}$	a_2	0.2236	b_{52}	0.0441	ch_2	0.6585	A_{31}	0.0069	Automation of concrete slab-on-grade construction	0.004466	1992
$Th_{61}A_{29}$	a_5	0.0373	b_{27}	0.0132	ch_2	0.6585	A_{29}	0.0310	Robotic materials handling for automated building construction technology	0.001005	1992
$Th_{157}A_{47}$		0.5776	b_{52}	0.0441	ch_3	0.1707	A_{47}	0.0034	Outpost service and construction robot (OSCR)	0.001496	1992
$Th_{36}A_7$	a_3	0.5776	b_{12}	0.0573	ch_6	0.0407	A_7	0.0207	Object-oriented programming in robotics research for excavation	0.002777	1992
$Th_{33}A_{20}$	a_3	0.5776	b_{21}	0.0044	ch_2	0.6585	A_{20}	0.0138	Full-scale building with interior finishing robot	0.002307	1993
$Th_{39}A_{22}$	a_3	0.5776	b_{55}	0.0044	ch_2	0.6585	A_{22}	0.0534	Prototype robotic masonry system	0.008941	1993
$Th_{142}A_7$	a_4	0.0311	b_{12}	0.0573	ch_2	0.6585	A_7	0.0207	Artificial intelligence in the control and operation of construction plant-the autonomous robot excavator	0.002419	1993
$Th_{126}A_6$	a_5	0.0373	b_2	0.1278	ch_2	0.6585	A_6	0.0723	Articulated multi-vehicle robot for inspection and testing of pipeline interiors =	0.022665	1993
$Th_{36}A_{21}$	a_3	0.5776	b_{12}	0.0573	ch_6	0.0407	A_{21}	0.0172	Automation potential of pipe laying operations	0.002315	1993
$Th_{151}A_{21}$		0.5776	b_{52}	0.0441	ch_1	0.1260	A_{21}	0.0172	Air Force construction automation/robotics	0.005519	1994
$Th_{40}A_{22}$	a_2	0.2236	b_{56}	0.0088	ch_2	0.6585	A_{22}	0.0534	Mobile robot for on-site construction of masonry	0.006922	1994
$Th_{40}A_{22}$	a_2	0.2236	b_{56}	0.0088	ch_2	0.6585	A_{22}	0.0534	A mobile robot for on-site construction of masonry	0.006922	1994

$Th_{19}A_{22}$	a_2	0.2236	b_2	0.1278	ch_2	0.6585	A_{22}	0.0534	Application specific realisation of a mobile robot for on-site construction of masonry	0.100372	1994
$Th_{98}A_6$	a_3	0.5776	b_{19}	0.0132	ch_2	0.6585	A_6	0.0723	A robotic manipulator for inspection and maintenance of tall structures	0.036342	1994
$Th_{13}A_{29}$	a_3	0.5776	b_7	0.0529	ch_2	0.6585	A_{29}	0.0310	Modularity of PRM type cartesian robots and their application in the production of construction materials	0.062300	1994
$Th_{60}A_{34}$	a_3	0.5776	b_{12}	0.0573	ch_2	0.6585	A_{34}	0.0413	Robotics and automation in the construction of the sliding domes of King Fahd's extension of the prophet's holy mosque in Madinah, Kingdom of Saudi Arabia	0.089989	1994
$Th_{22}A_{58}$	a_3	0.5776	b_{32}	0.0793	ch_2	0.6585	A_{58}	0.0069	Robot for interior-finishing works in building: Feasibility analysis	0.020767	1994
$Th_{25}A_{53}$		0.5776	b_{67}	0.0573	ch_2	0.6585	A_{53}	0.0069	Requirements for application of robotics and automation in highway maintenance and construction tasks	0.014998	1994
$Th_{23}A_{24}$		0.5776	b_{32}	0.0793	ch_2	0.6585	A_{24}	0.0224	Construction process simulation with rule-based robot path planning	0.067492	1994
$Th_{124}A_{59}$	a_2	0.2236	b_{12}	0.0573	ch_2	0.6585	A_{59}	0.0069	First results in autonomous retrieval of buried objects	0.005806	1995
$Th_{10}A_{11}$	a_3	0.5776	b_{16}	0.0132	ch_2	0.6585	A_{11}	0.0551	High tractive power wall-climbing robot	0.027689	1995
$Th_{34}A_{20}$	a_3	0.5776	b_{32}	0.0793	ch_2	0.6585	A_{20}	0.0138	Conceptual design of a flooring robot: development methodology and results	0.041533	1995
$Th_{49}A_{34}$		0.5776	b_{36}	0.0220	ch_2	0.6585	A_{34}	0.0413	Automatic assembly of a commercial cavity block system	0.034611	1995
$Th_{25}A_{54}$		0.5776	b_{67}	0.0573	ch_2	0.6585	A_{54}	0.0379	New TIG arc welding processes and welding robot for construction of storage tank	0.082490	1995
$Th_{25}A_{54}$		0.5776	b_{67}	0.0573	ch_2	0.6585	A_{54}	0.0379	Development of welding robot technology for civil engineering and construction	0.082490	1995
$Th_{28}A_{11}$		0.5776		0.1278	ch_2	0.6585	A_{11}	0.0551	Wall assembly robot - its development and its integration in construction management | Mauerwerksroboter - Entwicklung und Integration in die Ausfuehrungs-planung	0.267660	1995
$Th_{88}A_{44}$	a_3	0.5776	b_2	0.1278	ch_6	0.0407	A_{44}	0.0155	Task planning experiment toward an autonomous robot system for the construction of overhead distribution lines	0.004647	1995
Th_1A_1	a_2	0.2236	b_{32}	0.0793	ch_2	0.6585	A_1	0.0189	Evolution of an automated crack sealer: A study in construction technology development	0.022106	1996
$Th_{59}A_{28}$	a_3	0.5776	b_{15}	0.0132	ch_2	0.6585	A_{28}	0.0189	Development of a construction robot for marking on ceiling boards	0.009518	1996
$Th_{127}A_6$	a_3	0.5776	b_{36}	0.0220	ch_2	0.6585	A_6	0.0723	Automatic task modelling for sewer studies	0.060570	1996

$Th_{41}A_{22}$	a_5	0.0373	b_{12}	0.0573	ch_2	0.6585	A_{22}	0.0534	Methods of control for robotic brick masonry	0.007499	1996
$Th_{25}A_{54}$		0.5776	b_{67}	0.0573	ch_2	0.6585	A_{54}	0.0379	Compact arc welding robot system for huge construction parts	0.082490	1996
$Th_{28}A_{17}$		0.5776		0.1278	ch_2	0.6585	A_{17}	0.0103	Development of automated cleaning system for construction aluminum scaffolding boards	0.050186	1996
$Th_{64}A_{50}$		0.5776	b_{30}	0.0441	ch_3	0.1707	A_{50}	0.0516	Control of construction robots using camera-space manipulation	0.022433	1996
$Th_{11}A_{11}$	a_3	0.5776	b_{17}	0.0044	ch_2	0.6585	A_{11}	0.0551	Concept of a robot for interior building trades by the example of wall slits in masonry	0.009230	1997
Th_8A_8	a_3	0.5776	b_2	0.1278	ch_3	0.1707	A_8	0.0293	Construction manipulators of steel towers for the transmission of electricity	0.036865	1997
$Th_{62}A_{29}$	a_2	0.2236	b_2	0.1278	ch_1	0.1260	A_{29}	0.0310	Development of the construction methods for distribution line materials using a robot system remotely controlled from the ground	0.011152	1998
$Th_{24}A_{17}$	a_2	0.2236	b_{67}	0.0573	ch_2	0.6585	A_{17}	0.0103	Development of automated construction system for high-rise reinforced concrete buildings	0.008709	1998
$Th_{13}A_8$	a_3	0.5776	b_7	0.0529	ch_2	0.6585	A_8	0.0293	Robotic assembly of rebar cages for beams and columns	0.058839	1998
$Th_{60}A_{54}$	a_3	0.5776	b_{12}	0.0573	ch_2	0.6585	A_{54}	0.0379	Robotic welding speeds Olympic Stadium construction	0.082490	1998
$Th_{106}A_{49}$		0.5776	b_{49}	0.0264	ch_6	0.0407	A_{49}	0.0017	Construction manipulators for transmission towers	0.000107	1998
$Th_{152}A_{56}$	a_3	0.5776	b_{67}	0.0573	ch_1	0.1260	A_{56}	0.0688	Tele-operated construction robot using virtual reality - (CG presentation of virtual robot for increasing working efficiency)	0.028700	2000
$Th_{151}A_{56}$		0.5776	b_{52}	0.0441	ch_1	0.1260	A_{56}	0.0688	Master-Slave Control for Tele-Operation Construction Robot System	0.022077	2000
$Th_{12}A_{11}$	a_2	0.2236	b_7	0.0529	ch_2	0.6585	A_{11}	0.0551	Designing for automated construction	0.042873	2000
$Th_{19}A_{12}$	a_2	0.2236	b_2	0.1278	ch_2	0.6585	A_{12}	0.0241	Development of a robotic bridge maintenance system	0.045329	2000
$Th_{96}A_{45}$	a_3	0.5776	b_{34}	0.0044	ch_2	0.6585	A_{45}	0.0241	Automated cleaning of windows on standard facades	0.004038	2000
$Th_{112}A_{54}$		0.5776	b_{11}	0.0044	ch_2	0.6585	A_{54}	0.0379	Welding automation in space-frame bridge construction	0.006345	2001
$Th_{32}A_{20}$	a_2	0.2236	b_{12}	0.0573	ch_3	0.1707	A_{20}	0.0138	Technological enhancement and creation of a computer-aided construction system for the shotcreting robot	0.003010	2001
$Th_{85}A_{42}$	a_2	0.2236	b_3	0.0220	ch_1	0.1260	A_{42}	0.0086	Disaster restoration work for the eruption of Mt Usuzan using an unmanned construction system	0.000534	2002
$Th_{128}A_6$	a_3	0.5776	b_{70}	0.0176	ch_2	0.6585	A_6	0.0723	Adaptive control strategy of climbing robot for inspection applications in construction industry	0.048456	2002
$Th_{143}A_7$	a_4	0.0311	b_{33}	0.0044	ch_2	0.6585	A_7	0.0207	Robotic excavation in construction automation	0.000186	2002

$Th_{152}A_{56}$	a_3	0.5776	b_{67}	0.0573	ch_1	0.1260	A_{56}	0.0688	Development of a hydraulic tele-operated construction robot using virtual reality: New master-slave control method and an evaluation of a visual feedback system	0.028700	2003
$Th_{150}A_{56}$	a_2	0.2236	b_1	0.0088	ch_2	0.6585	A_{56}	0.0688	A Tele-operated Humanoid Robot Drives a Backhoe in the Open Air	0.008932	2003
$Th_{113}A_{54}$	a_3	0.5776	b_{10}	0.0044	ch_2	0.6585	A_{54}	0.0379	Portable robotic system for steel H-beam welding	0.006345	2003
$Th_{28}A_{11}$		0.5776		0.1278	ch_2	0.6585	A_{11}	0.0551	A cleaning robot for construction out-wall with complicated curve surface	0.267660	2003
$Th_{91}A_{56}$	a_1	0.0497	b_{67}	0.0573	ch_3	0.1707	A_{56}	0.0688	A remotely controlled robot operates construction machines	0.003345	2003
$Th_{55}A_{28}$	a_3	0.5776	b_{36}	0.0220	ch_6	0.0407	A_{28}	0.0189	Manipulators help out with plaster panels in construction	0.000979	2003
$Th_{117}A_{55}$	a_1	0.0497	b_2	0.1278	ch_1	0.1260	A_{55}	0.0275	Distance measurement technology development at remotely teleoperated robotic manipulator system for underwater constructions	0.002203	2004
$Th_{60}A_{28}$	a_3	0.5776	b_{12}	0.0573	ch_2	0.6585	A_{28}	0.0189	Construction of ceiling adsorbed mobile robots platform utilizing permanent magnet inductive traction method	0.041245	2004
$Th_{26}A_8$		0.5776	b_{49}	0.0264	ch_2	0.6585	A_8	0.0293	Adapting a teleoperated device for autonomous control using three-dimensional positioning sensors: experiences with the NIST RoboCrane	0.029419	2004
$Th_{14}A_{63}$		0.5776	b_7	0.0529	ch_2	0.6585	A_{63}	0.0086	Automated construction by contour crafting - related robotics and information technologies	0.017306	2004
$Th_{28}A_{11}$		0.5776		0.1278	ch_2	0.6585	A_{11}	0.0551	A service robot for construction industry	0.267660	2004
$Th_{107}A_{56}$		0.5776		0.1278	ch_1	0.1260	A_{56}	0.0688	Graphical simulation of remote control construction robot based on virtual reality	0.064024	2005
$Th_{65}A_{60}$	a_1	0.0497	b_{70}	0.0176	ch_2	0.6585	A_{60}	0.0086	A robotized drilling system for rocky wall consolidation	0.000496	2005
$Th_{129}A_6$	a_3	0.5776	b_{74}	0.0132	ch_2	0.6585	A_6	0.0723	Multiconfigurable inspection robots for low diameter canalizations	0.036342	2005
$Th_{130}A_6$	a_3	0.5776	b_{70}	0.0176	ch_2	0.6585	A_6	0.0723	Application of robots for inspection and restoration of historical sites	0.048456	2005
$Th_{28}A_{11}$		0.5776		0.1278	ch_2	0.6585	A_{11}	0.0551	The analysis of the curtain wall installation robot: Based on the test in the construction site	0.267660	2005
$Th_{81}A_{40}$	a_2	0.2236	b_{49}	0.0264	ch_3	0.1707	A_{40}	0.0034	Development of a parallel typed robot with a sensorless observer for harbor construction	0.000347	2005

Th_7A_{11}	a_5	0.0373	b_{20}	0.0044	ch_3	0.1707	A_{11}	0.0551	Development of hybrid robot for construction works with pneumatic actuator	0.000154	2005
$Th_{84}A_{41}$	a_1	0.0497	b_{30}	0.0441	ch_1	0.1260	A_{41}	0.0138	Development of a remote control system for construction machinery for rescue activities with a pneumatic robot	0.000380	2006
$Th_{118}A_{55}$	a_2	0.2236	b_3	0.0220	ch_1	0.1260	A_{55}	0.0275	Experiment on teleoperation of underwater backhoe with haptic information	0.001709	2006
$Th_{94}A_{56}$	a_2	0.2236		0.1278	ch_1	0.1260	A_{56}	0.0688	A novel distributed telerobotic system for construction machines based on modules synchronization	0.024783	2006
$Th_{18}A_{11}$	a_3	0.5776	b_{32}	0.0793	ch_1	0.1260	A_{11}	0.0551	Automation of incineration plant demolition and utilization of information technology	0.031791	2006
$Th_{86}A_{42}$		0.5776	b_3	0.0220	ch_1	0.1260	A_{42}	0.0086	Examination of practical utility of remotely controlled robots in disasters	0.001380	2006
$Th_{53}A_{23}$	a_3	0.5776	b_{66}	0.0044	ch_2	0.6585	A_{23}	0.0017	Using rescue robots to increase construction site safety	0.000288	2006
$Th_{51}A_{59}$		0.5776	b_{30}	0.0441	ch_2	0.6585	A_{59}	0.0069	Massive rock handling by a breaker - Graspless manipulation and object recognition	0.011537	2006
$Th_{25}A_{34}$		0.5776	b_{67}	0.0573	ch_2	0.6585	A_{34}	0.0413	Construction automation based on parts and packets unification	0.089989	2006
Th_8A_{11}	a_3	0.5776	b_2	0.1278	ch_3	0.1707	A_{11}	0.0551	A multidegree-of-freedom manipulator for curtain-wall installation	0.069393	2006
$Th_{89}A_{44}$		0.5776		0.1278	ch_3	0.1707	A_{44}	0.0155	The application of the human-robot cooperative system for construction robot manipulating and installing heavy materials	0.019517	2006
$Th_{38}A_{21}$	a_2	0.2236	b_{69}	0.0044	ch_1	0.1260	A_{21}	0.0172	Control schemes for tele-robotic pipe installation	0.000214	2007
$Th_{93}A_{44}$		0.5776	b_2	0.1278	ch_1	0.1260	A_{44}	0.0155	Intuitive OCU (Operator Control Unit) of MFR (Multipurpose Field Robot) on construction site	0.014405	2007
Th_1A_1	a_2	0.2236	b_{32}	0.0793	ch_2	0.6585	A_1	0.0189	Concrete paving productivity improvement using a multi-task autonomous robot	0.022106	2007
$Th_{80}A_6$	a_3	0.5776	b_{58}	0.0308	ch_2	0.6585	A_6	0.0723	A UAV for bridge inspection: Visual servoing control law with orientation limits	0.084797	2007
$Th_{16}A_{63}$	a_6	0.0807	b_{25}	0.0308	ch_2	0.6585	A_{63}	0.0086	Cable-suspended robotic contour crafting system	0.001411	2007
$Th_{146}A_8$		0.5776	b_{26}	0.0176	ch_2	0.6585	A_8	0.0293	Design of a bolting robot for constructing steel structure	0.019613	2007
$Th_{25}A_{63}$		0.5776	b_{67}	0.0573	ch_2	0.6585	A_{63}	0.0086	Cable-suspended robotic contour crafting system (vol 17, pg 45, 2007)	0.018748	2007
$Th_{56}A_{28}$	a_3	0.5776	b_{42}	0.0088	ch_3	0.1707	A_{28}	0.0189	Design of a ceiling glass installation robot	0.001645	2007

$Th_{63}A_6$	a_3	0.5776	b_{32}	0.0793	ch_3	0.1707	A_6	0.0723	Auto inspection system using a mobile robot for detecting concrete cracks in a tunnel	0.056532	2007
Th_8A_{11}	a_3	0.5776	b_2	0.1278	ch_3	0.1707	A_{11}	0.0551	Development of the curtain wall installation robot: Performance and efficiency tests at a construction site	0.069393	2007
Th_8A_{44}	a_3	0.5776	b_2	0.1278	ch_3	0.1707	A_{44}	0.0155	MFR (Multipurpose Field Robot) for installing construction materials	0.019517	2007
$Th_{70}A_{34}$		0.5776	b_{60}	0.0088	ch_3	0.1707	A_{34}	0.0413	Robotic technologies for the automatic assemble of massive beams in high-rise building	0.003589	2007
$Th_{90}A_{44}$		0.5776	b_{67}	0.0573	ch_3	0.1707	A_{44}	0.0155	Human-robot cooperation control for installing heavy construction materials	0.008749	2007
$Th_{122}A_{56}$	a_1	0.0497	b_{12}	0.0573	ch_1	0.1260	A_{56}	0.0688	Remote control of backhoe at construction site with a pneumatic robot system	0.002469	2008
$Th_{95}A_{44}$	a_3	0.5776	b_{32}	0.0793	ch_1	0.1260	A_{44}	0.0155	Power assist devices for installing plaster panels in construction	0.008941	2008
Th_2A_1	a_3	0.5776	b_{52}	0.0441	ch_2	0.6585	A_1	0.0189	A robotic system for road lane painting	0.031727	2008
$Th_{13}A_8$	a_3	0.5776	b_7	0.0529	ch_2	0.6585	A_8	0.0293	A new type of bolting robot for steel-frame structure constructions	0.058839	2008
$Th_{37}A_{21}$	a_2	0.2236	b_{25}	0.0308	ch_3	0.1707	A_{21}	0.0172	A comparison of two innovative technologies for safe pipe installation - "Pipeman" and the Stewart-Gough platform-based pipe manipulator	0.002026	2008
$Th_{57}A_{28}$	a_3	0.5776	b_{44}	0.0088	ch_3	0.1707	A_{28}	0.0189	Human robot cooperative control and task planning for a glass ceiling installation robot	0.001645	2008
$Th_{139}A_{60}$	a_3	0.5776	b_{12}	0.0573	ch_3	0.1707	A_{60}	0.0086	Autonomous drilling robot for landslide monitoring and consolidation	0.004861	2008
$Th_{71}A_{34}$		0.5776	b_{45}	0.0176	ch_3	0.1707	A_{34}	0.0413	Wearable haptic glove using micro hydraulic system for control of construction robot system with VR environment	0.007179	2008
$Th_{89}A_{10}$		0.5776		0.1278	ch_3	0.1707	A_{10}	0.0138	A human-robot cooperative system helps out with glass panels in construction	0.017348	2008
$Th_{144}A_8$	a_2	0.2236	b_{63}	0.0088	ch_6	0.0407	A_8	0.0293	Development of automation system for steel construction based on robotic crane	0.000234	2008
Th_3A_1	a_1	0.0497	b_2	0.1278	ch_2	0.6585	A_1	0.0189	Chronological development history of X-Y table based pavement crack sealers and research findings for practical use in the field	0.007915	2009
$Th_{129}A_6$	a_3	0.5776	b_{74}	0.0132	ch_2	0.6585	A_6	0.0723	Design, Construction, and testing of a new class of mobile robots for cave exploration	0.036342	2009

$Th_{13}A_8$	a_3	0.5776	b_7	0.0529	ch_2	0.6585	A_8	0.0293	Experimental evaluation of a robotic bolting device in steel beam assembly	0.058839	2009
$Th_{26}A_{29}$		0.5776	b_{49}	0.0264	ch_2	0.6585	A_{29}	0.0310	Basic study of smart robotic construction lift for increasing resource lifting efficiency in high-rise building construction	0.031150	2009
$Th_{145}A_8$	a_3	0.5776	b_{63}	0.0088	ch_3	0.1707	A_8	0.0293	Robotic automation system for steel beam assembly in building construction	0.002542	2009
$Th_{92}A_{44}$	a_2	0.2236	b_{24}	0.0088	ch_2	0.6585	A_{44}	0.0155	Climbing and pole line hardware installation robot for construction of distribution lines	0.002010	2010
$Th_{50}A_{45}$	a_3	0.5776	b_{36}	0.0220	ch_2	0.6585	A_{45}	0.0241	Self-traveling robotic system for autonomous abrasive blast cleaning in double-hulled structures of ships	0.020190	2010
$Th_{66}A_{10}$	a_3	0.5776	b_{25}	0.0308	ch_2	0.6585	A_{10}	0.0138	Implementation of a foldable 3-DOF master device to a glass window panel fitting task	0.016152	2010
$Th_{14}A_8$		0.5776	b_7	0.0529	ch_2	0.6585	A_8	0.0293	Mechanism and analysis of a robotic bolting device for steel beam assembly	0.058839	2010
$Th_{54}A_{26}$	a_2	0.2236	b_{61}	0.0132	ch_3	0.1707	A_{26}	0.0052	Development of a dual robotic arm system to evaluate intelligent system for advanced construction machinery	0.000261	2010
Th_8A_{44}	a_3	0.5776	b_2	0.1278	ch_3	0.1707	A_{44}	0.0155	An improved multipurpose field robot for installing construction materials	0.019517	2010
$Th_{119}A_{56}$	a_2	0.2236		0.1278	ch_1	0.1260	A_{56}	0.0688	Tele-operation construction robot control system with virtual reality technology	0.024783	2011
$Th_{68}A_{33}$	a_2	0.2236	b_{45}	0.0176	ch_2	0.6585	A_{33}	0.0069	Wearable robotic system using hydraulic actuator	0.001786	2011
$Th_{20}A_{12}$	a_3	0.5776	b_{57}	0.0132	ch_2	0.6585	A_{12}	0.0241	Field application of a robotic system on cable stays of incheon bridge for snow removal	0.012114	2011
$Th_{10}A_{19}$	a_3	0.5776	b_{16}	0.0132	ch_2	0.6585	A_{19}	0.0138	Development of building-façade maintenance robot with docking station based on vertical climbing mechanism	0.006922	2011
Th_4A_{20}	a_3	0.5776	b_2	0.1278	ch_2	0.6585	A_{20}	0.0138	Robot system for removing asbestos sprayed on beams	0.066915	2011
$Th_{97}A_{45}$	a_5	0.0373	b_{26}	0.0176	ch_2	0.6585	A_{45}	0.0241	An experimental study of automatic cleaning tool and robot for façade in high-rise buildings	0.001042	2011
$Th_{148}A_8$	a_6	0.0807	b_{24}	0.0088	ch_2	0.6585	A_8	0.0293	Real-time nde of steel cable using elasto-magnetic sensors installed in a cable climbing robot	0.001371	2011
$Th_{26}A_{17}$		0.5776	b_{49}	0.0264	ch_2	0.6585	A_{17}	0.0103	Development of robotic-crane based automatic construction system for steel structures of high-rise buildings	0.010383	2011

$Th_{28}A_{17}$		0.5776		0.1278	ch_2	0.6585	A_{17}	0.0103	Building of a sample scenario of a built-in guide type robot for external wall maintenance work of a skyscraper	0.050186	2011
$Th_{28}A_{19}$		0.5776		0.1278	ch_2	0.6585	A_{19}	0.0138	Window contamination detection method for the robotic building maintenance system	0.066915	2011
$Th_{28}A_{38}$		0.5776		0.1278	ch_2	0.6585	A_{38}	0.0155	Development of high accuracy position making system applying mark robot in construction site	0.075279	2011
$Th_{153}A_6$	a_3	0.5776	b_2	0.1278	ch_3	0.1707	A_6	0.0723	Robot-aided tunnel inspection and maintenance system by vision and proximity sensor integration	0.091079	2011
$Th_{82}A_{41}$	a_2	0.2236	b_{61}	0.0132	ch_6	0.0407	A_{41}	0.0138	Development of double arm working machine for demolition and scrap processing	0.000165	2011
$Th_{115}A_{55}$	a_3	0.5776	b_4	0.0044	ch_2	0.6585	A_{55}	0.0275	A robotic system for underwater eco-sustainable wire-cutting	0.004615	2012
$Th_{27}A_{28}$	a_3	0.5776	b_{46}	0.0088	ch_2	0.6585	A_{28}	0.0189	Autonomous construction of a roofed structure: Synthesizing planning and stigmergy on a mobile robot	0.006345	2012
$Th_{129}A_6$	a_3	0.5776	b_{74}	0.0132	ch_2	0.6585	A_6	0.0723	Hete+A184:H184rogeneous multi-configurable chained microrobot for the exploration of small cavities	0.036342	2012
$Th_{22}A_6$	a_3	0.5776	b_{32}	0.0793	ch_2	0.6585	A_6	0.0723	Design and construction of an in-pipe robot for inspection and maintenance	0.218050	2012
$Th_{28}A_{38}$		0.5776		0.1278	ch_2	0.6585	A_{38}	0.0155	High Accuracy Position Marking System Applying Mobile Robot in Construction Site	0.075279	2012
$Th_{63}A_3$	a_3	0.5776	b_{32}	0.0793	ch_3	0.1707	A_3	0.0069	Open robot control for services in construction	0.005384	2012
$Th_{64}A_{10}$		0.5776	b_{30}	0.0441	ch_3	0.1707	A_{10}	0.0138	An easy handling system for installing heavy glass using human robot cooperation	0.005982	2012
$Th_{107}A_5$		0.5776		0.1278	ch_1	0.1260	A_5	0.0120	Job planning and supervisory control for automated earthmoving using 3D graphical tools	0.011204	2013
$Th_{13}A_{29}$	a_3	0.5776	b_7	0.0529	ch_2	0.6585	A_{29}	0.0310	Development of an automated freeform construction system and its construction materials	0.062300	2013
$Th_{140}A_{63}$	a_6	0.0807	b_{57}	0.0132	ch_2	0.6585	A_{63}	0.0086	Optimal machine operation planning for construction by Contour Crafting	0.000605	2013
$Th_{51}A_7$		0.5776	b_{30}	0.0441	ch_2	0.6585	A_7	0.0207	Design and construction of a scale robotic excavator work-cell to test automated excavation algorithms	0.034611	2013
$Th_{147}A_8$	a_2	0.2236	b_7	0.0529	ch_3	0.1707	A_8	0.0293	Robot-based construction automation: An application to steel beam assembly (Part I)	0.005905	2013

$Th_{149}A_{10}$	a_3	0.5776	b_{62}	0.0044	ch_3	0.1707	A_{10}	0.0138	Prototype for glazed panel construction robot	0.000598	2013
Th_8A_8	a_3	0.5776	b_2	0.1278	ch_3	0.1707	A_8	0.0293	Robot-based construction automation: An application to steel beam assembly (Part II)	0.036865	2013
$Th_{58}A_{28}$		0.5776	b_{44}	0.0088	ch_3	0.1707	A_{28}	0.0189	Glazed ceiling panel construction robot	0.001645	2013
$Th_{64}A_{10}$		0.5776	b_{30}	0.0441	ch_3	0.1707	A_{10}	0.0138	Installation of heavy duty glass using an intuitive manipulation device	0.005982	2013
$Th_{137}A_{55}$	a_2	0.2236	b_2	0.1278	ch_1	0.1260	A_{55}	0.0275	Underwater construction robot for rubble leveling on the seabed for port construction	0.009913	2014
$Th_{131}A_6$	a_3	0.5776	b_{71}	0.0044	ch_2	0.6585	A_6	0.0723	Considerations regarding the construction of a minirobot for surveillance and inspection	0.012114	2014
$Th_{121}A_{57}$	a_3	0.5776	b_{83}	0.0088	ch_2	0.6585	A_{57}	0.0034	Towards a vision controlled robotic home environment	0.001154	2014
$Th_{47}A_5$	a_3	0.5776	b_{58}	0.0308	ch_2	0.6585	A_5	0.0120	Mobile 3D mapping for surveying earthwork projects using an Unmanned Aerial Vehicle (UAV) system	0.014133	2014
Th_4A_6	a_3	0.5776	b_2	0.1278	ch_2	0.6585	A_6	0.0723	A lightweight bridge inspection system using a dual-cable suspension mechanism	0.351303	2014
$Th_{31}A_2$		0.5776	b_1	0.0088	ch_2	0.6585	A_2	0.0086	Towards On-Site Autonomous Robotic Floor Tiling of Mosaics	0.002884	2014
$Th_{26}A_{10}$		0.5776	b_{49}	0.0264	ch_2	0.6585	A_{10}	0.0138	Introduction of human-robot cooperation technology at construction sites	0.013844	2014
$Th_{46}A_{34}$		0.5776	b_{58}	0.0308	ch_2	0.6585	A_{34}	0.0413	Collision-free 4D trajectory planning in Unmanned Aerial Vehicles for assembly and structure construction	0.048456	2014
$Th_{105}A_{47}$	a_2	0.2236	b_2	0.1278	ch_3	0.1707	A_{47}	0.0034	Robotic explosive charging in mining and construction applications	0.001679	2014
$Th_{72}A_{34}$		0.5776	b_{42}	0.0088	ch_3	0.1707	A_{34}	0.0413	In-Situ fabrication: Mobile robotic units on construction sites	0.003589	2014
$Th_{30}A_{19}$	a_2	0.2236	b_{57}	0.0132	ch_2	0.6585	A_{19}	0.0138	A robotic cutting tool for contaminated structure maintenance and decommissioning	0.002680	2015
$Th_{116}A_{55}$	a_3	0.5776	b_5	0.0044	ch_2	0.6585	A_{55}	0.0275	Design and construction of a robot hand prototype for underwater applications	0.004615	2015
$Th_{121}A_{57}$	a_3	0.5776	b_{83}	0.0088	ch_2	0.6585	A_{57}	0.0034	Assistive robotic micro-rooms for independent living	0.001154	2015
Th_2A_6	a_3	0.5776	b_{52}	0.0441	ch_2	0.6585	A_6	0.0723	A low-cost robotic system for the efficient visual inspection of tunnels	0.121139	2015
$Th_{52}A_{29}$	a_6	0.0807	b_{13}	0.0132	ch_2	0.6585	A_{29}	0.0310	Cable robot for non-standard architecture and construction: A dynamic positioning system	0.002177	2015

$Th_{43}A_{22}$		0.5776	b_{54}	0.0044	ch_2	0.6585	A_{22}	0.0534	Between Manual and Robotic Approaches to Brick Construction in Architecture Expanding the Craft of Manual Bricklaying with the Help of Video Projection Techniques	0.008941	2015
$Th_{29}A_{28}$	a_3	0.5776	b_{45}	0.0176	ch_3	0.1707	A_{28}	0.0189	Ceiling work scenario based hardware design and control algorithm of supernumerary robotic limbs	0.003290	2015
$Th_{108}A_5$	a_2	0.2236	b_{32}	0.0793	ch_1	0.1260	A_5	0.0120	Key challenges in automation of earth-moving machines	0.002692	2016
$Th_{136}A_6$	a_3	0.5776	b_{19}	0.0132	ch_1	0.1260	A_6	0.0723	Design and analysis of climbing robot based on construction surface inspection	0.006954	2016
$Th_{120}A_{56}$	a_3	0.5776	b_{32}	0.0793	ch_1	0.1260	A_{56}	0.0688	Prototyping a remotely-controlled machine for concrete surface griding operations	0.039739	2016
$Th_{110}A_{50}$	a_4	0.0311	b_{52}	0.0441	ch_1	0.1260	A_{50}	0.0516	An electro-hydraulic servo controller for construction robot using system-on-chip device	0.000890	2016
$Th_{44}A_{22}$	a_6	0.0807	b_{26}	0.0176	ch_2	0.6585	A_{22}	0.0534	Automated construction of masonry buildings using cable- driven parallel robots	0.004999	2016
$Th_{109}A_{37}$		0.5776	b_{78}	0.0088	ch_2	0.6585	A_{37}	0.0155	Study on parts processing of the traditional wooden construction method using articulated robot	0.005192	2016
$Th_{109}A_{50}$		0.5776	b_{78}	0.0088	ch_2	0.6585	A_{50}	0.0516	Local search on trees and a framework for automated construction using multiple identical robots	0.017306	2016
$Th_{14}A_{37}$		0.5776	b_7	0.0529	ch_2	0.6585	A_{37}	0.0155	Robotic timber construction - Expanding additive fabrication to new dimensions	0.031150	2016
$Th_{23}A_{29}$		0.5776	b_{32}	0.0793	ch_2	0.6585	A_{29}	0.0310	Autonomous construction with compliant building material	0.093450	2016
$Th_{74}A_{34}$	a_3	0.5776	b_9	0.0044	ch_3	0.1707	A_{34}	0.0413	Automation of modular assembly of structural frames for buildings	0.001795	2016
$Th_{29}A_{29}$	a_3	0.5776	b_{45}	0.0176	ch_3	0.1707	A_{29}	0.0310	Applications of supernumerary robotic limbs to construction works: Case studies	0.005384	2016
$Th_{73}A_{34}$		0.5776	b_{30}	0.0441	ch_3	0.1707	A_{34}	0.0413	Human-Machine Interaction for Intuitive Programming of Assembly Tasks in Construction	0.017947	2016
$Th_{104}A_{45}$	a_3	0.5776	b_{35}	0.0044	ch_1	0.1260	A_{45}	0.0241	Development of a wall-climbing platform with modularized wall-cleaning units	0.000773	2017
$Th_{138}A_6$	a_3	0.5776	b_2	0.1278	ch_1	0.1260	A_6	0.0723	Autonomous robotic system with tunnel inspection tool positioning	0.067225	2017
$Th_{65}A_{30}$	a_1	0.0497	b_{70}	0.0176	ch_2	0.6585	A_{30}	0.0103	Three types of robot builder for the unsupervised construction of Mars habitats	0.000595	2017

$Th_{45}A_{22}$	a_3	0.5776	b_{59}	0.0044	ch_2	0.6585	A_{22}	0.0534	Robotic mechanical design for brick-laying automation	0.008941	2017
$Th_{47}A_6$	a_3	0.5776	b_{58}	0.0308	ch_2	0.6585	A_6	0.0723	Wall contact by octo-rotor UAV with one DoF manipulator for bridge inspection	0.084797	2017
$Th_{22}A_{15}$	a_3	0.5776	b_{32}	0.0793	ch_2	0.6585	A_{15}	0.0086	Development of a novel post-construction quality assessment robot system	0.025958	2017
$Th_{22}A_6$	a_3	0.5776	b_{32}	0.0793	ch_2	0.6585	A_6	0.0723	Design and construction of an inspection robot for the sewage pipes	0.218050	2017
$Th_{16}A_{11}$	a_6	0.0807	b_{25}	0.0308	ch_2	0.6585	A_{11}	0.0551	Autonomous big-scale additive manufacturing using cable-driven robots	0.009031	2017
$Th_{15}A_{11}$		0.5776	b_{23}	0.0044	ch_2	0.6585	A_{11}	0.0551	JA-WA - A wall construction system using unilateral material application with a mobile robot	0.009230	2017
$Th_{67}A_{60}$		0.5776	b_{75}	0.0044	ch_2	0.6585	A_{60}	0.0086	Industrial robots application in the construction of buildings and structures	0.001442	2017
$Th_{111}A_{52}$		0.5776	b_{16}	0.0132	ch_2	0.6585	A_{52}	0.0103	Towards force-aware robot collectives for on-site construction	0.005192	2017
$Th_{46}A_6$		0.5776	b_{58}	0.0308	ch_2	0.6585	A_6	0.0723	Construction inspection with unmanned aerial vehicle [Bauwerksinspektion mit unbemannten Flugsystemen]	0.084797	2017
$Th_{23}A_{15}$		0.5776	b_{32}	0.0793	ch_2	0.6585	A_{15}	0.0086	A Novel Building Post-Construction Quality Assessment Robot: Design and Prototyping	0.025958	2017
$Th_{77}A_9$		0.5776	b_2	0.1278	ch_2	0.6585	A_9	0.0069	Construction Techniques Used to Automatically Pass Standard Box Girders through Special Passenger-Line Tunnels	0.033457	2017
$Th_{28}A_6$		0.5776		0.1278	ch_2	0.6585	A_6	0.0723	Bottom-up cognitive analysis of bionic inspection robot for construction site	0.351303	2017
$Th_{75}A_{34}$	a_5	0.0373	b_7	0.0529	ch_3	0.1707	A_{34}	0.0413	Design of Modular Re-configurable Robotic System for Construction and Digital Fabrication	0.001389	2017
$Th_{64}A_3$		0.5776	b_{30}	0.0441	ch_3	0.1707	A_3	0.0069	On-Site Robotic Construction Assistance for Assembly Using A-Priori Knowledge and Human-Robot Collaboration	0.002991	2017
$Th_{99}A_{45}$	a_3	0.5776	b_{37}	0.0044	ch_2	0.6585	A_{45}	0.0241	Floor cleaning robot with reconfigurable mechanism	0.004038	2018
$Th_{154}A_6$	a3	0.5776	b_{46}	0.0088	ch_2	0.6585	A_6	0.0723	Development of a robot for boiler tube inspection	0.024228	2018
$Th_{98}A_{45}$	a_3	0.5776	b_{19}	0.0132	ch_2	0.6585	A_{45}	0.0241	Glass facade cleaning robot with passive suction cups and self-locking trapezoidal lead screw drive	0.012114	2018
$Th_{133}A_6$	a_3	0.5776	b_3	0.0220	ch_2	0.6585	A_6	0.0723	Automatic inspection of embankment by crawler-type mobile robot	0.060570	2018

Th_2A_6	a_3	0.5776	b_{52}	0.0441	ch_2	0.6585	A_6	0.0723	Automatic traveling method for the self-propelled tunnel inspection system	0.121139	2018
$Th_{22}A_6$	a_3	0.5776	b_{32}	0.0793	ch_2	0.6585	A_6	0.0723	Localisation of a mobile robot for bridge bearing inspection	0.218050	2018
Th_4A_6	a_3	0.5776	b_2	0.1278	ch_2	0.6585	A_6	0.0723	Tunnel structural inspection and assessment using an autonomous robotic system	0.351303	2018
$Th_{42}A_{22}$	a_6	0.0807	b_{53}	0.0044	ch_2	0.6585	A_{22}	0.0534	CU-brick cable-driven robot for automated construction of complex brick structures: From simulation to hardware realisation	0.001250	2018
$Th_{44}A_{22}$	a_6	0.0807	b_{26}	0.0176	ch_2	0.6585	A_{22}	0.0534	Process analysis of cable-driven parallel robots for automated construction	0.004999	2018
$Th_{16}A_{11}$	a_6	0.0807	b_{25}	0.0308	ch_2	0.6585	A_{11}	0.0551	Cable-driven parallel robot for curtain wall modules automatic installation	0.009031	2018
$Th_{76}A_{34}$	a_6	0.0807	b_{25}	0.0308	ch_2	0.6585	A_{34}	0.0413	On the Improvements of a Cable-Driven Parallel Robot for Achieving Additive Manufacturing for Construction	0.006773	2018
$Th_{114}A_{54}$		0.5776	b_{14}	0.0044	ch_2	0.6585	A_{54}	0.0379	A Changeable Jig-Less Welding Cell for Subassembly of Construction Machinery	0.006345	2018
$Th_{132}A_6$		0.5776	b_{72}	0.0088	ch_2	0.6585	A_6	0.0723	Robotic inspection tests of tunnel lining concrete with crack light-section device on variable guide frame	0.024228	2018
$Th_{132}A_6$		0.5776	b_{72}	0.0088	ch_2	0.6585	A_6	0.0723	Concrete inspection systems using hammering robot imitating sounds of workers	0.024228	2018
Th_6A_{11}		0.5776	b_{13}	0.0132	ch_2	0.6585	A_{11}	0.0551	Robotic application of foam concrete onto bare wall elements - Analysis, concept and robotic experiments	0.027689	2018
Th_5A_{11}		0.5776	b_{27}	0.0132	ch_2	0.6585	A_{11}	0.0551	Improvement of the mobile robot location dedicated for habitable house construction by 3D printing	0.027689	2018
$Th_{46}A_{22}$		0.5776	b_{58}	0.0308	ch_2	0.6585	A_{22}	0.0534	Feasibility study for drone-based masonry construction of real-scale structures	0.062589	2018
$Th_{23}A_{30}$		0.5776	b_{32}	0.0793	ch_2	0.6585	A_{30}	0.0103	Planetary Lego: Designing a Construction Block from a Regolith Derived Feedstock for In Situ Robotic Manufacturing	0.031150	2018
$Th_{77}A_6$		0.5776	b_2	0.1278	ch_2	0.6585	A_6	0.0723	Automatic multi-image stitching for concrete bridge inspection by combining point and line features	0.351303	2018
$Th_{28}A_{19}$		0.5776		0.1278	ch_2	0.6585	A_{19}	0.0138	Smart construction robot technology to improve construction and safety in outer walls of high-rise buildings	0.066915	2018
$Th_{28}A_{28}$		0.5776		0.1278	ch_2	0.6585	A_{28}	0.0189	Automation of the execution of monolithic reinforced ceilings	0.092008	2018

$Th_{125}A_6$	a_3	0.5776	b_{73}	0.0044	ch_3	0.1707	A_6	0.0723	A semi-autonomous mobile robot for bridge inspection	0.003141	2018
$Th_{87}A_{42}$	a_2	0.2236	b_{61}	0.0132	ch_1	0.1260	A_{42}	0.0086	Dual-arm construction robot with remote-control function	0.000320	2019
$Th_{86}A_{42}$		0.5776	b_3	0.0220	ch_1	0.1260	A_{42}	0.0086	Efforts to unmanned construction for post-disaster restoration and reconstruction	0.001380	2019
$Th_{135}A_6$	a_1	0.0497	b_{15}	0.0132	ch_2	0.6585	A_6	0.0723	Control of a hyper-redundant robot for quality inspection in additive manufacturing for construction	0.003126	2019
$Th_{69}A_{60}$	a_2	0.2236	b_{76}	0.0044	ch_2	0.6585	A_{60}	0.0086	A novel holonomic mobile manipulator robot for construction sites	0.000558	2019
$Th_{101}A_{45}$	a_3	0.5776	b_{38}	0.0044	ch_2	0.6585	A_{45}	0.0241	Self-reconfigurable façade-cleaning robot equipped with deep-learning-based crack detection based on convolutional neural networks	0.004038	2019
$Th_{100}A_{45}$	a_3	0.5776	b_{39}	0.0044	ch_2	0.6585	A_{45}	0.0241	Four-wheel steering and driving mechanism for a reconfigurable floor cleaning robot	0.004038	2019
$Th_{103}A_{45}$	a_3	0.5776	b_{40}	0.0044	ch_2	0.6585	A_{45}	0.0241	Design and modelling of a modular window cleaning robot	0.004038	2019
$Th_{102}A_{45}$	a_3	0.5776	b_{41}	0.0044	ch_2	0.6585	A_{45}	0.0241	Parallel 2-DoF manipulator for wall-cleaning applications	0.004038	2019
$Th_{79}A_{38}$	a_3	0.5776	b_{79}	0.0088	ch_2	0.6585	A_{38}	0.0155	Mobile robot for marking free access floors at construction sites	0.005192	2019
$Th_{79}A_{38}$	a_3	0.5776	b_{79}	0.0088	ch_2	0.6585	A_{38}	0.0155	Development of automated mobile marking robot system for free access floor	0.005192	2019
$Th_{134}A_6$	a_3	0.5776	b_{13}	0.0132	ch_2	0.6585	A_6	0.0723	QuicaBot: Quality Inspection and Assessment Robot	0.036342	2019
$Th_{48}A_{22}$	a_3	0.5776	b_{36}	0.0220	ch_2	0.6585	A_{22}	0.0534	Labview based brick laying robot	0.044706	2019
$Th_{17}A_{11}$	a_6	0.0807	b_{28}	0.0044	ch_2	0.6585	A_{11}	0.0551	Design, modelling and simulation of novel hexapod-shaped passive damping system for coupling cable robot and end effector in curtain wall module installation application (wall)	0.001290	2019
$Th_{16}A_{22}$	a_6	0.0807	b_{25}	0.0308	ch_2	0.6585	A22	0.0534	Investigation of robot systems in masonry construction [Baubetriebliche Untersuchung von Robotersystemen im Mauerwerksbau]	0.008749	2019
$Th_{46}A_6$		0.5776	b_{58}	0.0308	ch_2	0.6585	A_6	0.0723	Indoor visualization experiments at building construction site using high safety UAV	0.084797	2019
$Th_{51}A_{22}$		0.5776	b_{30}	0.0441	ch_2	0.6585	A_{22}	0.0534	Automatic brick masonry system and its application in on-site construction	0.089412	2019
$Th_{14}A_{44}$		0.5776	b_7	0.0529	ch_2	0.6585	A_{44}	0.0155	Towards Automated Installation of Reinforcement Using Industrial Robots	0.031150	2019
$Th_{77}A_{37}$		0.5776	b_2	0.1278	ch_2	0.6585	A_{37}	0.0155	Robotic fabrication of nail laminated timber	0.075279	2019

$Th_{77}A_{37}$		0.5776	b_2	0.1278	ch_2	0.6585	A_{37}	0.0155	Adaptive automation strategies for robotic prefabrication of parametrized mass timber building components	0.075279	2019
$Th_{77}A_{41}$		0.5776	b_2	0.1278	ch_2	0.6585	A_{41}	0.0138	Construction waste recycling robot for nails and screws: Computer vision technology and neural network approach	0.066915	2019
$Th_{28}A_{30}$		0.5776		0.1278	ch_2	0.6585	A_{30}	0.0103	In-situ construction method for lunar habitation: Chinese Super Mason	0.050186	2019
$Th_{21}A_{13}$		0.5776	b_{31}	0.0044	ch_3	0.1707	A_{13}	0.0034	User interfaces for human-robot interaction in field robotics	0.000150	2019
$Th_{158}A_{36}$	a2	0.2236	b_{27}	0.0132	ch_1	0.1260	A_{36}	0.0086	Controller area network standard for unmanned ground vehicles hydraulic systems in construction applications	0.000320	2020
$Th_{78}A_{37}$	a3	0.5776	b_{48}	0.0044	ch_2	0.6585	A_{37}	0.0155	Flexible and transportable robotic timber construction platform – TIM	0.002596	2020
$Th_{155}A_{37}$		0.5776	b_{50}	0.0044	ch_2	0.6585	A_{37}	0.0155	Automated manufacturing for timber-based panelised wall systems	0.002596	2020
$Th_{83}A_{41}$		0.5776	b_{60}	0.0088	ch_2	0.6585	A_{41}	0.0138	Development of an automatic sorting robot for construction and demolition waste	0.004615	2020
$Th_{51}A_{22}$		0.5776	b_{30}	0.0441	ch_2	0.6585	A_{22}	0.0534	Automation of the construction process by using a hinged robot with interchangeable nozzles	0.089412	2021

- occurrence probability of TeA_i related papers

Term labels	Subcategory labels				Papers (title)	Probability	Publication years
	ce_i	P	A_i	P			
$Te_{14}A_{54}$	ce_{14}	0.1304	A_{54}	0.0379	Application of robotics in bridge deck fabrication	0.493901	1989
Te_2A_{53}	ce_2	0.0870	A_{53}	0.0069	Robotics in highway construction & maintenance	0.059867	1995
Te_9A_{29}	ce_9	0.0870	A_{29}	0.0310	Automated construction system for high-rise reinforced concrete buildings	0.269401	2000
$Te_{14}A_{35}$	ce_{14}	0.1304	A_{35}	0.0103	Balancing human-and-robot integration in building tasks	0.134700	2004
Te_6A_{12}	ce_6	0.0870	A_{12}	0.0241	Intelligent painting process planner for robotic bridge painting	0.209534	2007
Te_9A_{29}	ce_9	0.0870	A_{29}	0.0310	Task management of robots for the automatic construction	0.269401	2008
$Te_{10}A_{14}$	ce_{10}	0.1304	A_{14}	0.0138	Position error modeling for automated construction manipulators	0.179600	2009
$Te_{12}A_{35}$	ce_{12}	0.0870	A_{35}	0.0103	Development of conceptual model of construction factory for automated construction	0.089800	2009
Te_7A_{21}	ce_7	0.0435	A_{21}	0.0172	A performance evaluation of a Stewart platform based Hume concrete pipe manipulator	0.074833	2009
$Te_{10}A_{52}$	ce_{10}	0.1304	A_{52}	0.0103	Relative accuracy enhancement system based on internal error range estimation for external force measurement in construction manipulator	0.134700	2011
Te_4A_9	ce_4	0.0435	A_9	0.0069	Dimension optimization of an orientation fine-tuning manipulator for segment assembly robots in shield tunneling machines	0.029933	2011
Te_5A_{10}	ce_5	0.0435	A_{10}	0.0138	A methodology to quantitatively evaluate the safety of a glazing robot	0.059867	2011
$Te_{11}A_{56}$	ce_{11}	0.0435	A_{56}	0.0688	Evaluation of construction robot telegrasping force perception using visual, auditory and force feedback integration	0.299334	2012
$Te_{10}A_{35}$	ce_{10}	0.1304	A_{35}	0.0103	Analysis on autonomous task trajectory tracking performance of construction robot with online gravity compensation	0.134700	2013
$Te_{12}A_{35}$	ce_{12}	0.0870	A_{35}	0.0103	A framework of indicators for assessing construction automation and robotics in the sustainability context	0.089800	2015
Te_6A_{12}	ce_6	0.0870	A_{12}	0.0241	Bridge maintenance automation	0.209534	2016
Te_1A_{11}	ce_1	0.0435	A_{11}	0.0551	Potential benefits of digital fabrication for complex structures: Envitonmental assessment of a robotically fabricated concrete-wall	0.239467	2017
$Te_{14}A_{35}$	ce_{14}	0.1304	A_{35}	0.0103	Improved productivity, efficiency and cost savings following implementation of drone technology in the surveying industry	0.134700	2018
$Te_{15}A_{16}$	ce_{15}	0.0435	A_{16}	0.0189	Framework for human performance analysis in Unmanned Aircraft System (UAS) operations in dynamic construction environment (concrete printing)	0.082317	2018

Te_3A_{22}	ce_3	0.0435	A_{22}	0.0534	The analysis of factors influencing on efficiency of applying mobile bricklaying robots and tools for such analysis	0.231984	2019
$Te_{13}A_{35}$	ce_{13}	0.0435	A_{35}	0.0103	A Comprehensive Performance Evaluation of Different Mobile Manipulators Used as Displaceable 3D Printers of Building Elements for the Construction Industry	0.044900	2020
Te_2A_{22}	ce_2	0.0870	A_{22}	0.0534	Determining a numerical efficiency indicator for a mobile bricklaying robot	0.463968	2020
Te_8A_{21}	ce_8	0.0435	A_{21}	0.0172	Life cycle cost analysis of the steel pipe pile head cutting robot	0.074833	2020