

ARK 2018

16TH INTERNATIONAL SYMPOSIUM ON ADVANCES IN ROBOT KINEMATICS

JULY 1ST – JULY 5TH 2018 | BOLOGNA, ITALY

CONFERENCE PROGRAM



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI INGEGNERIA INDUSTRIALE



UNDER THE PATRONAGE OF



COMUNE DI
BOLOGNA



ARK 2018
is Bologna

ABOUT ARK 2018

ARK 2018, THE 16TH INTERNATIONAL SYMPOSIUM ON ADVANCES IN ROBOT KINEMATICS, IS ORGANIZED BY THE GROUP OF ROBOTICS, AUTOMATION AND BIOMECHANICS (GRAB) AT THE DEPARTMENT OF INDUSTRIAL ENGINEERING OF THE UNIVERSITY OF BOLOGNA, ITALY.

COMMITTEES

CONFERENCE CHAIRMEN

J. LENARČIČ, J. STEFAN INSTITUTE, LJUBLJANA, SLOVENIA
V. PARENTI-CASTELLI, UNIVERSITY OF BOLOGNA, ITALY

HONORARY CHAIRMAN

B. ROTH, STANFORD UNIVERSITY, USA

SCIENTIFIC COMMITTEE

J. ANGELES, MCGILL UNIVERSITY, CANADA
M. HUSTY, UNIVERSITY OF INNSBRUCK, AUSTRIA
A. KECSKEMETHY, UNIVERSITY OF DUISBURG, GERMANY
O. KHATIB, STANFORD UNIVERSITY, USA
J. LENARČIČ, J. STEFAN INSTITUTE, LJUBLJANA, SLOVENIA
J. M. MCCARTHY, UNIVERSITY OF CALIFORNIA AT IRVINE, USA
V. PARENTI-CASTELLI, UNIVERSITY OF BOLOGNA, ITALY
F. PARK, SEOUL NATIONAL UNIVERSITY, KOREA
A. PEREZ, IDAHO STATE UNIVERSITY, USA
J. SELIG, LONDON SOUTH BANK UNIVERSITY, UK
B. SICILIANO, UNIVERSITY OF NAPLES "FEDERICO II", ITALY
M. M. STANISIC, UNIVERSITY OF NOTRE DAME, USA
F. THOMAS, INSTITUTE OF INDUSTRIAL ROBOTICS, SPAIN
P. WENGER, ECOLE CENTRALE DE NANTES, FRANCE

LOCAL ORGANIZING COMMITTEE

V. PARENTI-CASTELLI, UNIVERSITY OF BOLOGNA, ITALY
M. CARRICATO, UNIVERSITY OF BOLOGNA, ITALY
R. VERTECHY, UNIVERSITY OF BOLOGNA, ITALY
Y. WU, UNIVERSITY OF BOLOGNA, ITALY

CONFERENCE SECRETARIAT

FONDAZIONE ALMA MATER



CONFERENCE PROGRAM

OVERALL PROGRAM

SUNDAY JULY 1ST		
19:00	21:30	WELCOME RECEPTION AND REGISTRATION

MONDAY JULY 2ND		SESSION NAME
08:00	08:40	REGISTRATION
08:20	08:40	WELCOME SPEECH
08:40	10:00	SESSION 1.1
10:00	10:20	COFFEE BREAK
10:20	12:00	SESSION 1.2
		COMPUTATIONAL KINEMATICS 1
		THEORETICAL KINEMATICS

12:00	14:00	LUNCH
-------	-------	-------

14:00	15:40	SESSION 2.1
15:40	16:00	COFFEE BREAK
16:00	17:20	SESSION 2.2
17:30	18:30	MEETING TC CK
		SINGULARITIES 1
		DYNAMICS & CONTROL

19:30	20:30	STELUTIS CHOIR CONCERT
-------	-------	------------------------

TUESDAY JULY 3RD		SESSION NAME
08:20	10:00	SESSION 3.1
10:00	10:20	COFFEE BREAK
10:20	11:40	SESSION 3.2
		COMPUTATIONAL KINEMATICS 2
		SINGULARITIES 2

11:40	13:00	LUNCH
-------	-------	-------

13:30	19:00	VISITS TO DUCATI FACTORY AND BOLOGNA CITY HALL
-------	-------	--

WEDNESDAY JULY 4TH		SESSION NAME
08:40	10:20	SESSION 4.1
10:20	10:40	COFFEE BREAK
10:40	12:00	SESSION 4.2
		MODELING 1
		COMPUTATIONAL KINEMATICS 3

12:00	13:20	LUNCH
-------	-------	-------

13:20	15:00	SESSION 5.1
15:00	15:20	COFFEE BREAK
15:20	16:40	SESSION 5.2
16:40	18:10	ROUND TABLE
		CABLE-DRIVEN PARALLEL ROBOTS
		DESIGN
		30 YEARS OF ARK: PAST, PRESENT AND FUTURE

20:00	22:30	GALA DINNER
-------	-------	-------------

THURSDAY JULY 5TH		SESSION NAME
08:20	10:00	SESSION 6.1
10:00	10:20	COFFEE BREAK
10:20	11:40	SESSION 6.2
11:40	12:00	CLOSING REMARKS
		BIOROBOTICS
		MODELING 2



CONFERENCE PROGRAM

MONDAY, JULY 2ND, 2018

SESSION 1.1: COMPUTATIONAL KINEMATICS 1.			CHAIR: J. LENARČIČ
08:40	09:00	ACCURATE COMPUTATION OF QUATERNIONS FROM ROTATION MATRICES	SOHEIL SARABANDI, FEDERICO THOMAS
09:00	09:20	REDUNDANCY PARAMETRIZATION IN GLOBALLY-OPTIMAL INVERSE KINEMATICS	ENRICO FERRENTINO, PASQUALE CHIACCHIO
09:20	09:40	SOLUTION FOR THE DIRECT KINEMATICS PROBLEM OF THE GENERAL STEWART-GOUGH PLATFORM BY USING ONLY LINEAR ACTUATORS' ORIENTATIONS	STEFAN SCHULZ, ARTHUR SEIBEL, JOSEF SCHLATTMANN
09:40	10:00	ANALYTICAL DETERMINATION OF A SPHERE INSIDE WHICH THE STEWART PLATFORM TRANSLATES WITHOUT SUFFERING ANY LINK INTERFERENCE	ANIRBAN NAG, SANDIPAN BANDYOPADHYAY
10:00	10:20	COFFEE BREAK	

SESSION 1.2: THEORETICAL KINEMATICS.			CHAIR: J.M. MCCARTHY
10:20	10:40	KINEMATIC INTERPRETATION OF THE STUDY QUADRIC'S AMBIENT SPACE	GEORG NAWRATIL
10:40	11:00	INPUT-OUTPUT EQUATION FOR PLANAR FOUR-BAR LINKAGES	JOHN HAYES, MANFRED HUSTY, MARTIN PFURNER
11:00	11:20	PRINCIPAL KINEMATIC INEQUALITIES	GREGORY CHIRIKJIAN
11:20	11:40	DISPLACEMENT VARIETIES FOR SOME PUP LINKAGES	JONATHAN SELIG
11:40	12:00	LINE SYMMETRIC MOTION GENERATORS	YUANQING WU, MARCO CARRICATO
12:00	14:00	LUNCH + SCIENTIFIC COMMITTEE LUNCH	

SESSION 2.1: SINGULARITIES 1.			CHAIR: M. HUSTY
14:00	14:20	KINEMATIC ANALYSIS OF PLANAR TENSEGRITY 2-X MANIPULATORS	MATTHIEU FURET, PHILIPPE WENGER, MAX LETTL
14:20	14:40	ROTATIONAL MOBILITY ANALYSIS OF THE 3-RFR CLASS OF SPHERICAL PARALLEL ROBOTS	DAVID CORINALDI, LUCA CARBONARI, MATTEO PALPACELLI, MASSIMO CALLEGARI
14:40	15:00	RANDOMIZED PLANNING OF DYNAMIC MOTIONS AVOIDING FORWARD SINGULARITIES	RICARD BORDALBA, LLUÍS ROS, JOSEP M. PORTA
15:00	15:20	ANALYSIS OF KINEMATIC SINGULARITIES FOR A SERIAL REDUNDANT MANIPULATOR WITH 7 DOF	ZIJIA LI, MATHIAS BRANDSTÖTTER, MICHAEL HOFBAUR
15:20	15:40	A GEOMETRIC METHOD OF SINGULARITY AVOIDANCE FOR KINEMATICALLY REDUNDANT PLANAR PARALLEL ROBOTS	NICHOLAS BARON, ANDREW PHILIPPIDES, NICOLAS ROJAS
15:40	16:00	COFFEE BREAK	

SESSION 2.2: DYNAMICS & CONTROL.			CHAIR: B. SICILIANO
16:00	16:20	LATERAL STABILITY OF A 3-DOF ASYMMETRICAL SPHERICAL PARALLEL MANIPULATOR WITH A UNIVERSAL JOINT FEATURING INFINITE TORSIONAL MOVEMENT	GUANGLEI WU, HUIPING SHEN
16:20	16:40	ON THE USE OF INSTANT CENTERS TO BUILD DYNAMIC MODELS OF SINGLE-DOF PLANAR MECHANISMS	RAFFAELE DI GREGORIO
16:40	17:00	NORMAL FORMS OF ROBOTIC SYSTEMS WITH AFFINE PFAFFIAN CONSTRAINTS: A CASE STUDY	KRZYSZTOF TCHON, JOANNA RATAJCZAK, JANUSZ JAKUBIAK
17:00	17:20	GENERALIZED PATH FOLLOWING CONSTRAINTS WITH SPATIAL CURVES FOR ROLLER COASTER APPLICATIONS	JORGE AMBROSIO, PEDRO ANTUNES, MARIO VIEGAS

17:30	18:30	MEETING OF THE IFToMM TECHNICAL COMMITTEE FOR COMPUTATIONAL KINEMATICS
-------	-------	--

19:30	20:30	STELUTIS CHOIR CONCERT, SAN GIOVANNI IN MONTE CHURCH, PIAZZA S. GIOVANNI IN MONTE 3, BOLOGNA
-------	-------	--



CONFERENCE PROGRAM

TUESDAY, JULY 3RD, 2018

SESSION 3.1: COMPUTATIONAL KINEMATICS 2.			CHAIR: F. THOMAS
8:20	8:40	HIGHER-ORDER RELATIVE KINEMATICS OF RIGID BODY MOTIONS. A DUAL LIE ALGEBRA APPROACH	DANIEL CONDURACHE
8:40	9:00	AN ALGORITHM FOR TRAJECTORY GENERATION IN REDUNDANT MANIPULATORS WITH JOINT TRANSMISSION ACCOMMODATION	BAHRAM RAVANI, KRISTOPHER WEHAGE
9:00	9:20	EVALUATION OF DYNAMIC RELAXATION TO SOLVE KINEMATICS OF CONCENTRIC TUBE ROBOTS	QUENTIN PEYRON, KANTY RABENOROSOA, NICOLAS ANDREFF, PIERRE RENAUD
9:20	9:40	ITERATIVE METHOD FOR THE INVERSE KINEMATICS OF A 3-LIMB PARALLEL MECHANISM WITH 3-DOF USING A 6-LIMB MECHANISM WITH 6-DOF	XINGHAI LIANG, YUKIO TAKEDA
9:40	10:00	OPTIMAL OBJECT PLACEMENT USING A VIRTUAL AXIS	MARTIN GEORG WEIß
10:00	10:20	COFFEE BREAK	

SESSION 3.2: SINGULARITIES 2.			CHAIR: P. WENGER
10:20	10:40	THE 3-PPPS PARALLEL ROBOT WITH U-SHAPE BASE, A 6-DOF PARALLEL ROBOT WITH SIMPLE KINEMATICS	DAMIEN CHABLAT, LUC BARON, RANJAN JHA, LUC ROLLAND
10:40	11:00	ON THE SINGULARITIES OF A PARALLEL ROBOTIC SYSTEM USED IN ELBOW AND WRIST REHABILITATION	IOSIF BIRLESCU, BOGDAN GHERMAN, CALIN VAIDA, DOINA PISLA, NICOLAE PLITEA, ADRIAN PISLA, GIUSEPPE CARBONE
11:00	11:20	KINEMATIC CONSTRAINT MAPS AND C-SPACE SINGULARITIES FOR PLANAR MECHANISMS WITH PRISMATIC JOINTS	SEYEDVAHID AMIRINEZHAD, PETER DONELAN
11:20	11:40	TRANSVERSALITY AND ITS APPLICATIONS TO KINEMATICS	SEYEDVAHID AMIRINEZHAD, PETER DONELAN, ANDREAS MUELLER
11:40	13:00	LUNCH	

13:30	16:30	VISIT TO DUCATI FACTORY, VIA ANTONIO CAVALIERI DUCATI 3, BOLOGNA
17:30	19:00	CITY HALL: WELCOME ADDRESS AND VISIT, PALAZZO D'ACCURSIO, PIAZZA MAGGIORE 6, BOLOGNA



CONFERENCE PROGRAM

WEDNESDAY, JULY 4TH, 2018

SESSION 4.1: MODELING 1.			CHAIR: J. ANGELES
8:40	9:00	A GENERAL DISCRETIZATION-BASED APPROACH FOR THE KINETOSTATIC ANALYSIS OF CLOSED-LOOP RIGID/FLEXIBLE HYBRID MECHANISMS	GENLIANG CHEN, ZHUANG ZHANG, ZHENGTAO CHEN, HAO WANG
9:00	9:20	A PURE-INERTIA METHOD FOR DYNAMIC BALANCING OF SYMMETRIC PLANAR MECHANISMS	JAN DE JONG, YUANQING WU, MARCO CARRICATO, JUST HERDER
9:20	9:40	STIFFNESS AND DEFORMATION OF MECHANISMS WITH LOCALLY FLEXIBLE BODIES: A GENERAL METHOD USING EXPANDED PASSIVE JOINTS	GONZALO MORENO, JULIO FRANTZ, LAURO NICOLAZZI, RODRIGO DE SOUZA VIEIRA, DANIEL MARTINS
9:40	10:00	KINEMATIC CHARACTERISTICS OF PARALLEL CONTINUUM MECHANISMS	OSCAR ALTUZARRA, DIEGO CABALLERO, QIUCHEN ZHANG, FRANCISCO J. CAMPA
10:00	10:20	SPATIAL ORIENTATIONS OF PRINCIPAL VECTOR PLANES FOR INHERENT DYNAMIC BALANCING	VOLKERT VAN DER WIJK
10:20	10:40	COFFE BREAK	

SESSION 4.2: COMPUTATIONAL KINEMATICS 3.			CHAIR: J. SELIG
10:40	11:00	NOVEL PLÜCKER OPERATORS AND A DUAL RODRIGUES FORMULA APPLIED TO THE IKP OF GENERAL 3R CHAINS	BERTOLD BONGARDT
11:00	11:20	THE FORWARD KINEMATICS OF DOUBLY-PLANAR GOUGH-STEWART PLATFORMS AND THE POSITION ANALYSIS OF STRIPS OF TETRAHEDRA	JOSEP M PORTA, FEDERICO THOMAS
11:20	11:40	SIX-BAR LINKAGE DESIGN SYSTEM WITH A PARALLELIZED POLYNOMIAL HOMOTOPY SOLVER	JEFFREY GLABE, MICHAEL MCCARTHY
11:40	12:00	ALGEBRAIC ANALYSIS OF A 3-RUU PARALLEL MANIPULATOR	THOMAS STIGGER, ABHILASH NAYAK, PHILIPPE WENGER, STÉPHANE CARO, MARTIN PFURNER, MANFRED HUSTY
12:00	13:20	LUNCH	

SESSION 5.1: CABLE-DRIVEN PARALLEL ROBOTS.			CHAIR: F. PARK
13:20	13:40	ENERGY CONSUMPTION REDUCTION OF A CABLE-DRIVEN STORAGE AND RETRIEVAL SYSTEM	TOBIAS BRUCKMANN, CHRISTOPHER REICHERT, HONGQIAN JI
13:40	14:00	COMPUTING CROSS-SECTIONS OF THE WORKSPACE OF A CABLE-DRIVEN PARALLEL ROBOT WITH 6 SAGGING CABLES HAVING LIMITED LENGTHS	JEAN-PIERRE MERLET
14:00	14:20	A UNIFIED APPROACH TO FORWARD KINEMATICS FOR CABLE-DRIVEN PARALLEL ROBOTS BASED ON ENERGY	ANDREAS POTT, PHILIPP TEMPEL
14:20	14:40	KINEMATIC MODELING AND TWIST FEASIBILITY OF MOBILE CABLE-DRIVEN PARALLEL ROBOTS	TAHIR RASHEED, PHILIP LONG, DAVID MARQUEZ-GAMEZ, STÉPHANE CARO
14:40	15:00	KINETOSTATIC CHARACTERIZATION OF A LOADING SYSTEM BASED ON A PARTIALLY-DECOUPLED PARALLEL MANIPULATOR	GIULIO SPAGNUOLO, NICOLA SANCISI, ROCCO VERTECHY, VINCENZO PARENTI-CASTELLI
15:00	15:20	COFFE BREAK	

SESSION 5.2: DESIGN.			CHAIR: A. KECSKEMETHY
15:20	15:40	MANIPULABILITY AND MACHINE LEARNING	FRANK PARK
15:40	16:00	KINEMATIC SYNTHESIS OF PLANAR MULTI-LIMB MECHANISMS FOR MULTI-DIRECTIONAL INTERACTION WITH BODIES IN THE ENVIRONMENT	NINA ROBSON, GIM SONG SOH
16:00	16:20	A NOVEL ROTARY POSITIONER WITH SINGLE DRIVE: STRUCTURAL ANALYSIS AND KINEMATIC DESIGN	ALEXEY FOMIN, VICTOR A. GLAZUNOV
16:20	16:40	A NEW MECHANISM FOR THE DEPLOYMENT OF MODULAR SOLAR ARRAYS: KINEMATIC AND STATIC ANALYSIS	STEFANO SERIANI, PAOLO GALLINA, LORENZO SCALERA, ALESSANDRO GASPARETTO, ARMIN WEDLER

16:40	18:10	ROUND TABLE: "30 YEARS OF ARK: PAST, PRESENT AND FUTURE"
-------	-------	--

20:00	22:30	GALA DINNER, OFFICER'S CLUB, PALAZZO GRASSI, VIA MARSALA 12, BOLOGNA
-------	-------	--



CONFERENCE PROGRAM

THURSDAY, JULY 5TH, 2018

SESSION 6.1: BIOROBOTICS.			CHAIR: O. KHATIB
8:20	8:40	KINEMATIC ANALYSIS OF A NOVEL PARALLEL 2SPRR+1U ANKLE MECHANISM IN HUMANOID ROBOT	SHIVESH KUMAR, ABHILASH NAYAK, HEINER PETERS, CHRISTOPHER SCHULZ, ANDREAS MUELLER, FRANK KIRCHNER
8:40	9:00	ONLINE CALIBRATION PROCEDURE FOR MOTION TRACKING WITH WEARABLE SENSORS USING KALMAN FILTERING	ALESSANDRO FILIPPESCHI, EMANUELE RUFFALDI, LORENZO PEPPOLONI, CARLO ALBERTO AVIZZANO
9:00	9:20	SENSITIVITY ANALYSIS AND IDENTIFICATION OF HUMAN PARAMETERS FOR AN ADAPTIVE, UNDERACTUATED HAND EXOSKELETON	ANTONIO DI GUARDO, MINE SARAC, MASSIMILIANO GABARDI, DANIELE LEONARDIS, MASSIMILIANO SOLAZZI, ANTONIO FRISOLI
9:20	9:40	GAIT PHASES DETECTION USING A 6 D.O.F. ANKLE JOINT ELECTRO-GONIOMETER	DUNG CAI, PHILIPPE BIDAUD, LONG TRIET GIANG HUYNH
9:40	10:00	FLUOROSCOPY VALIDATION OF NONINVASIVE 3D BONE-POSE TRACKING VIA EXTERNAL PRESSURE-FOILS	NIKOLAS BUFE, GREGOR KUNTZE, JANET LENORE RONSKY, ANDRES KECSKEMETHY
10:00	10:20	COFFE BREAK	

SESSION 6.2: MODELING 2.			CHAIR: V. PARENTI-CASTELLI
10:20	10:40	STATIC MODELING OF SAGGING CABLES WITH FLEXURAL RIGIDITY AND SHEAR FORCES	HUSSEIN HUSSEIN, MARC GOUTTEFARDE, FRANÇOIS PIERROT
10:40	11:00	FROM DIFFERENTIAL GEOMETRY OF CURVES TO HELICAL KINEMATICS OF CONTINUUM ROBOTS USING EXPONENTIAL MAPPING	STANISLAO GRAZIOSO, GIUSEPPE DI GIRONIMO, BRUNO SICILIANO
11:00	11:20	A LIGAMENT MODEL BASED ON FIBRE MAPPING FOR MULTIBODY SIMULATIONS	FABRIZIO NARDINI, NICOLA SANCISI, VINCENZO PARENTI-CASTELLI
11:20	11:40	EXPERIMENTAL IDENTIFICATION OF STRESS-STRAIN MATERIAL MODELS OF UHMWPE FIBER CABLES FOR IMPROVING CABLE TENSION CONTROL STRATEGIES	PHILIPP TEMPEL, FELIX TRAUTWEIN, ANDREAS POTT
11:40	12:00	CLOSING REMARKS	



ARK 2018

SPONSORS

THE ORGANIZERS OF ARK 2018 GRATEFULLY ACKNOWLEDGE THE GENEROUS SPONSORSHIP OFFERED BY:



AND ALSO BY:



UNDER THE PATRONAGE OF



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI INGEGNERIA INDUSTRIALE



COMUNE DI
BOLOGNA



ARK 2018
is Bologna