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Decreto Rettore Università di Roma "La Sapienza" n 140/2018 del 17/1/2018

Giovanni Battista PALMERINI
Curriculum Vitae

Completed in Roma, 16/2/2018
Released for publication

Part I – General Information

Full Name	Giovanni Battista PALMERINI
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Spoken Languages	English, French (in addition to Italian, mother tongue)

Part II – Education

Type	Year	Institution	Notes (Degree, Experience,…)
Laurea (5 years course)	1991	Università di Roma "La Sapienza"	Ingegneria Aeronautica, 110/110 e lode, thesis in Structural Dynamics
PhD	1996	Università di Roma "La Sapienza" (finals at Politecnico di Milano)	PhD in Aerospace Engineering, thesis on Satellite Constellations' Orbital Dynamics and Control

Part III – Appointments

III.1 – Academic Appointments

Start	End	Institution	Position
5/1996	10/2000	Università degli Studi di Roma "La Sapienza", Scuola di Ingegneria Aerospaziale	Ricercatore (ING-IND/05 Impianti e Sistemi Aerospaziali)
6/1996	12/1996	Stanford University	Visiting Scholar
11/2000	to date	Sapienza Università di Roma, Scuola di Ingegneria Aerospaziale	Professore associato
11/2003	7/2010	Università di Bologna, II Facoltà di Ingegneria	Professore a contratto

[1] This CV has been prepared according to the model defined by Sapienza. Following model instructions, and in order to address the peculiar requirements of this call, specific sentences and sub-paragraphs - *in italic* – have been added to the relevant, or the more relevant, headings already present in the standard form.

III.2 – Other Appointments (Research and Professional)

Start	End	Institution	Position
4/1991	7/1991	NASA Langley Research Center (USA)	Visiting Student, Structural Acoustics Branch
1/1992	4/1992	ITALSPAZIO S.p.A., Roma	Consultant, S/C Attitude Dynamics
4/1992	7/1993	Marina Militare Italiana, Accademia di Livorno e Comando Capitanerie di Porto	Cadet, then Officer with duties including Satellite-based Search and Rescue Operations (COSPAS/SARSAT system)
5/1996	10/2000	Scuola di Ingegneria Aerospaziale	UNISAT team member, to design, manufacture and launch (9/2000 from Baikonur)the 1st Italian university satellite
4/1998	7/1998	Interspace, Roma	Consultant, Space Debris Monitoring
9/2000	9/2007	ESA and Sapienza Univ. Roma	Experiment Manager for RSIS (RadioScence in Space) onboard SMART-1 ESA mission to the Moon
4/2004	9/2008	NATO, RTO Research and Technology Organization	Lead Author for the AGARD study about use of GPS in Flight Test activities
4/2007	5/2007	Vitrociset, Roma	Consultant, Remote Sensing Constellation

III.3 – Specific appointments concerning the evaluation of research programs

2006	*European Commission, Research Directorate General*	*Expert Evaluator, International Scientific Cooperation program*
2008	*Regione Piemonte – Research Support Initiative*	*Evaluator*
2012	*MIUR – PRIN*	*Evaluator*
2012-2013	*European Commission, Research Executive Agency*	*Expert Evaluator, FP7 program*
2013	*MIUR – Programma Futuro in Ricerca*	*Evaluator*
2014	*Univ. Padova – PISCOPIA Marie Curie Project*	*Evaluator*
2014-2015	*Nat.l Center for Science and Technology, Kazakhstan*	*Expert Evaluator*
2014-2015	*Univ. Padova – Research Funding Call*	*Evaluator*
2014-2016	*European Commission, Research Executive Agency*	*Expert Evaluator, H2020 program*
2015-2017	*European Commission, Research Executive Agency*	*Monitor, FP7 program*
2017	*Regione Campania – Innovation Funding Call*	*Evaluator*
2017-to date	*European Commission, Research Executive Agency*	*Monitor, H2020program*
2018	*European Commission, Executive Agency for SMEs*	*Expert Evaluator, H2020 program*

III.4 – Specific appointments concerning the cooperation to academic organization

With respect to the requirement of the call about the helpful roles in the University organization, following performed tasks referred to Sapienza Università di Roma can be recalled:
- member of the School panel for teaching support and evaluation in 2003,
- member of the Department board for a three years term,
- member of the Department panel for the library in 2010,
- member of the Aerospace Engineering CAD panel for the organization of curriculum and courses between 2012 and 2014,

- (at present) point of contact for Erasmus and International programs for the School of Aerospace Engineering,

With respect to the general academic duties (in addition to PhD courses offices and different specific accreditation tasks recalled later):
- member of the jury for assistant professor (Politecnico di Torino, 2006),
– international member of the jury for associate professor tenure (National Research Institute of Astronomy and Geodesy, Cairo, Egypt, 2008).

III.5 – Lab-related accomplishments

With respect to the requirement of the call about the build-up and management of labs:
- creation, promotion and management of the Guidance and Navigation Lab , settled in 2010 at Urbe, via Salaria site. The lab carries on cooperative research involving staff from the School and two other departments from Sapienza, and currently hosts 4 PhD candidates, 1 visiting student, 6 graduate students all performing their research and theses. Available facilities include GNSS equipment with a re-irradiator and several receivers, with a multiple antenna Septentrio high quality model allowing for attitude determination tests, the PINOCCHIO autonomous platform (described later within the part devoted to research activities) with a polite granite surface and the relevant equipment for avionics and for compressed air floating system, a small autonomous rover, a testbed to replicate relative proximity dynamics controlled by computer vision and a small number of manipulators.

Part IV – Teaching experience

With respect to the requirements of the call about teaching in language, course labelled in English shall be intended as actually taught in English. All listed university courses were/are advertised by the Schools as relevant to ING-IND/05 disciplines.

Courses taught are reported according to their level and date. [SIA=Scuola di Ingegneria Aerospaziale, FI=Facoltà di Ingegneria, then Ingegneria Civile e Industriale; courses taught at SIA were and are actually followed by graduate and post-graduate students].

IV.1 Undergraduate courses:

Year	Institution	Lecture/Course
2003/10	Università Bologna, II Fac. di Ingegneria	Navigazione Aerea (5 credits)

IV.2 Graduate courses:

2000/02	Sapienza Univ. di Roma, SIA	Sistemi di Guida e Navigazione Aerospaziali (10 credits)
2003/07	Sapienza Univ. di Roma, SIA	Navigazione Satellitare (5 credits)
2003/07	Sapienza Univ. di Roma, SIA	Guida e Navigazione (5 credits)
2005/07	Sapienza Univ. di Roma, SIA	Navigazione Inerziale (5 credits)
2008/10	Sapienza Univ. di Roma, FI	Guida e Navigazione Aerea (9 credits)
2008/12	Sapienza Univ. di Roma, SIA	Sistemi di Guida e Navigazione Aerospaziali (9 credits)
2013/16	Sapienza Univ. di Roma, FI	Sistemi di Guida Spaziale (6 credits)
2013/16	Sapienza Univ. di Roma, FI	Navigazione (6 credits) [since 2014 taught in English]
2015/18	Sapienza Univ. di Roma, SIA	Fundamentals of Space Systems/Navigation (6 credits)
2016/18	Sapienza Univ. di Roma, SIA	Orbit Determination (6 and 9 credits)

IV.3 Post-graduate courses:

2006/18	Sapienza Univ. Roma, FI (Master in Space Transportation Systems)	Launchers GNC
2016/18	Sapienza Univ. Roma, FI (PhD course in Energy and Environment)	GNSS Applications in Engineering

In addition, there are some short courses and seminars, taught at graduate level:

4/7/2014	University of Surrey (UK)	Seminar on GN Lab Activities
2/2016	Instituto Técnologico de Aéronautica (Sao José dos Campos (Brazil)	One week mini-course on Space Robotics
19/4/2016	Università di Bologna	GNSS Navigation in Lunar Missions

IV.4 Teaching evaluation

With respect to the requirements of the call about teaching action evaluation, the official data generated from the students' forms and published by Sapienza/CAD Ingegneria Aerospaziale (http://www.ingaero.uniroma1.it/index.php?option=com_content&view=article&id=1716&Itemid=2055&lang=it) are reported below. Data are the latest available, and are all referred to the graduate course in Sistemi di Guida Spaziale (data relevant to other courses – also positive - were not published as computed on a smaller group of students and indeed not deemed to be significant).

Questionario ↓ Anno accademico →	2013-14	2014-15	2015-16
Soddisfazione complessiva Media delle risposte al quesito: *- Sono complessivamente soddisfatto di come è stato svolto questo insegnamento?*	ALTO	ALTO	ALTO
Aspetti organizzativi Media delle risposte ai quesiti: *- Il materiale didattico (indicato e disponibile) è adeguato per lo studio della materia?* *- Le modalità d'esame sono state definite in modo chiaro?* *- Gli orari di svolgimento di lezioni, esercitazioni e altre eventuali attività didattiche sono rispettati?* *- L'insegnamento è stato svolto in maniera coerente con quanto dichiarato sul sito web del corso di studio?*	ALTO	ALTO	ALTO
Azione didattica Media delle risposte ai quesiti: *- Il docente stimola/motiva l'interesse verso la disciplina?* *- Il docente espone gli argomenti in modo chiaro?* *- Il docente è reperibile per chiarimenti e spiegazioni?*	ALTO	ALTO	ALTO

Marks read as follows: alto (average between 8 and 10), medio (6 to 7.9), basso (1 to 5.9). As a benchmark, the general average for the Laurea magistrale in Ingegneria Spaziale e Astronautica, the curriculum this course belonged to, was 6.8/7.7/7.6 in the three areas in 2013/14, 7.5, 8.1, 7.9 in 2014/15 and 7.3/8/7.8 in 2015/16.

IV.5 Tutoring

With respect to the specific requirement of the call about tutoring activities:
- main advisor for 6 PhD (Dr. Marco Sabatini, now technical staff at Sapienza, Dr. Pier Domenico Tromboni, presently at ENAV, Dr. Chiara Toglia, now at Thales Alenia Space, Dr. Fabrizio Reali, currently at Telespazio, Dr. Leonard Felicetti, at present senior lecturer at Luleå University, Sweden, and Dr. Emanuele Medaglia, now at EUMETSAT) and – currently - for two PhD candidates;
- main advisor (as professor) of 25 graduate theses, 6 undergraduate theses, 3 postgraduate master theses and co-advisor (as teaching assistant, assistant professor and professor) of about 30 theses;
- supervisor for several student internships (Telespazio, AerSud Aérospatiale, Pescara Airport, Northrop Grumman Italia, Thales Alenia Space) for undergraduate and graduate students at Sapienza Università di Roma and University of Bologna;
- academic lead of the team from Sapienza-Scuola di Ingegneria Aerospaziale participating and ranking first at the 2008 BEXUS ESA campaign with the experiment LowCoINS onboard a stratospheric balloon flying out of Kiruna (Sweden);
- mentor of several graduate and undergraduate incoming ERASMUS students at Sapienza and University of Bologna, and thesis advisor for outgoing Sapienza students to SupAéro Toulouse and Cranfield University.

IV.6 Courses organization and evaluation

With respect to the specific requirement of the call about the capabilities in proposing, preparing, managing curriculum, and in the accreditation of the courses:

2012-14	Sapienza/CAD Ing.Aerospaziale: panel on Aerospace Engineering courses and curriculum
2015	Member of the Conseil du domain Espace de la formation d'ingénieur, ISAE-SupAéro (France)
2016	Expert evaluator for the SKVC - Center for Quality Assessment in Higher Education, in the evaluation of the aerospace engineering programs, Vilnius (Lithuania)
2017	Chair of the expert team for the accreditation of the University courses in the transportation area, AIC Academic Information Center, Riga (Latvia)

IV.7 PhD Board participation

2000-2010	Sapienza Univ. Roma, member of the board of the PhD course in Aerospace Engineering
2012-to date	Sapienza Univ. Roma, member of the board of the PhD course in Energy and Environment

including the participation to the relevant panels for admission, and participation, according to the following appointments, in the evaluation of the final dissertations (PhD jurys):

10/2005	Politecnico di Milano
6/2006	Cairo University (Egypt), Faculty of Science
12/2007	Università di Napoli Federico II
4/2008	Cairo University (Egypt), Faculty of Science
3/2016	Università di Padova
6/2016	Ecole Polytechnique Féderale de Lausanne (EPFL) -Laboratoires de Neuchatel
9-12/2016	University of Surrey (2 Jurys)
12/2016	INSAE-SupAéro Toulouse
2/2017	Cranfield University
1/2018	Università di Bologna

IV.8 Cooperation with industry in continuing education

With respect to the relevant requirement of the call, the specialized (short) courses taught in the frame of continuing education programs in cooperation with leader aerospace firms are as follows:

2007	Thales Alenia Space, Roma and Torino sites	Satellite Formation Flying for Earth Observation
2010	ENAV (managed by Sapienza DIET)	Strumenti di Bordo per la Navigazione Aerea
2011	Northrop Grumman Italia	Advanced Navigation Techniques

Part V - Society memberships, Awards and Honors

V.1 Membership of Academic and Professional Institutions

Year	Title
2016-to date	Elected as corresponding member of the International Academy of Astronautics
2014-to date	Member of the Space Communications and Navigation (SCAN) Technical Committee of the International Astronautical Federation
2008-to date	Member of the Italian delegation to the International Committee for GNSS (IGC)
1996-to date	Member (currently Senior Member) of the American Institute of Aeronautics and Astronautics (AIAA)
2015-to date	Member of the Institute of Electrical and Electronics Engineers (IEEE)
1996-to date	Professional Member of the Institute of Navigation (ION)
1995-to date	Member of Associazione Italiana di Aeronautica e Astronautica (AIDAA)

V.2 Roles and appointments at Specialist Conferences

Invited speaker at the following conferences:

1997	1st IAF International Workshop on Mission Design and Implementation of Satellite Constellations, Toulouse
2000	US/European Celestial Mechanics Workshop, Poznan
2008	International Conference on Astronomy and Geophysics, Helwan

Conference Organization tasks:

2004-to date	IEEE Aerospace Conference – Organizer and Chair for the sessions on Space Mission Design: Technological Requirements and Orbit Selection" (2004-06), "Mission Design for Spacecraft Formations" (since 2007) e "Spacecraft Guidance Navigation and Control" (since 2008)
2009	Member of the Technical Committee of ENC09 – European Navigation Conference organized by the National Institutes for Navigation.
2015-to date	International Astronautical Congress – Technical Committee member, rapporteur for the session on Advanced Space Communication and Navigation Systems (since 2015) and co-chair for the session on "Mobile Satellite Communications and Navigation Technology" (since 2017)
2018	Member of the Technical Committee of MECHATRONICS2018 - 16th Mechatronics Forum International Conference, organized by University of Strathclyde and IET.

In addition, served as session chair at several national and international conferences including IEEE Metrology for Aerospace (2014), IET Symposium on Spacecraft Robotics (2015), IAA Conf. on Small Satellites (2017) and AIDAA national Congresses (2007-09-15-17).

V.3 Editiorial Boards and Peer Review Invitations

Member of the Editorial Board of the *Chinese Journal of Aeronautics* (published by Elsevier, with latest IF=1.3 and ranked either in Q1 or Q2 in the Aerospace Engineering domain) and of *Machines* (open access journal published by MDPI and indexed by WoS and Scopus since 2017).

Reviewer – either in recent years or at the present time - for several specialist, highly ranked journals, including:

- *Acta Astronautica, Advances in Space Research, Aerospace Science and Technology, Journal of Sound and Vibration,* (Elsevier),
- *Journal of Aerospace Engineering* (ASCE),
- *Journal of Guidance, Control and Dynamics, Journal of Spacecraft and Rockets* (AIAA),
- *Proceedings of the IMechE, Part G: Journal of Aerospace Engineering,* and *Part I: Journal of Systems and Control Engineering* (SAGE)
- *Sensors* (MDPI)
- *The Journal of Navigation* (Cambridge University Press)
- *Transactions on Aerospace and Electronic Systems, Transactions on Industrial Electronics* (IEEE).
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With regard to this activity, Giovanni Palmerini has been awarded a *Certificate for Outstanding Contribution in Reviewing* in January 2014 by the Editors of *Acta Astronautica* and in January 2015 by the Editors of *Advances in Space Research*.

Part VI - Funding Information [grants as PI-principal investigator or I-investigator]

Funding information since 2000 are reported. Grant value reported as "team" or "Rome" are the parts of the total funding relevant to the Guidance and Navigation Lab and indeed in full command.

Year	Role	Funding Inst.	Program	Grant value(k€)*
2018	PI	MBDA	Advanced/Emerging Opportunity Nav Techniques	*(TBD)*
2018	I	EDA	Virtual and Real Constellations of Satellites	164 (team40)
2017	PI	GAUSS	Small Satellite Platform Architecture	20
2017	recipient	MIUR	FABR (attività base ricerca)	3
2016	PI	Sapienza	Navigazione spaziale di prossimità mediante combinazione di immagini originate da più punti di vista	3
2015/16	Proposal manager/ I	FiLaS Lazio	Laboratori a supporto Attività Spaziali	7
2015	PI	Sapienza	GNSS/image-based guidance of autonomous vehicles	4
2014/16	I	MIUR	Cluster SAPERE/STRONG Pride Robotic Operations	team 33
2014	PI	Sapienza	Navigazione per immagini nelle operazioni spaziali	2
2013/15	PI Sapienza team	ESA	Weak GNSS Signal Navigation on the Moon	250/Roma55
2012/14	Proposal manager/ I	Astrium	Study on Debris Removal by means of Robotic Arms	85
2012	PI	Sapienza	Strumentazione per la navigazione e la guida di sistemi robotici nello spazio	9
2010	I	Reg. Lazio	Integrazione Nac/Comm per piccoli aeroporti	46(team 19)
2009/10	Proposal manager/ I	Min.Difesa - CeMiSS	Sciami di veicoli: tracking, guida, controllo e navigazione	12
2009	PI	Sapienza	Tecniche integrate di navigazione satellitare e ottica	15
2007/09	PI Sapienza team	ESA	Novel Time Synchronization Techniques for Deep Space Probes	40
2007/09	PI national+local	MIUR	(PRIN) Tecniche Tecnologie e Test per Formation Flying	203/Roma50
2007	PI	Sapienza	Navigazione di precisione in LEO mediante GNSS	4
2006	PI	SIA	Ricevitori satellitari ad architettura aperta	3
2005	PI	Sapienza	Navigazione orbitale relativa con GPS e Galileo	3
2004/06	PI national+local	MIUR	(PRIN) Architetture e componenti per la navigazione Aerospaziale	86/Roma50
2004	PI	Sapienza	Puntamento non inerziale a ridotta azione di controllo	4
2003	PI	SIA	Applicazioni navigazione satellitare ai sistemi di lancio	4
2002	PI	SIA	Analisi e sperimentazione di ricevitori satellitari	4
2001	PI	SIA	Architetture innovative per l'esplorazione spaziale	5
2000	PI	SIA	Navigazione relativa per il volo in formazione	4

In addition, it is possible to mention the participation as investigator – and sometimes as proposal manager too - in a large number of the projects funded by ASI and MIUR (PI for Sapienza teams prof. F.Graziani) which in the years from 1994 to 2002 led to the development and launch of the UNISAT platform.

With respect to the requirements of the call:
The two PRIN programs required the coordination of 2 (2004) and 4 (2007) teams from different Italian Universities.
ESA programs are based on the cooperation among different teams from different nations.
ESA programs awarding is based on the comparison/competition among bidders. MIUR (except SAPERE/STRONG) and Sapienza programs are based on peer review.

Part VII – Research Activities

In the following, required short survey of the main research interests it has been attempted to provide some – even really partial - reference with respect to the published work. Indeed, indications like [x] are referred to the list of publications submitted for the evaluation – when a letter is also present, they instead refer to the complete list of publications that has been attached to offer a global view of the activities carried on.

Keywords	Brief Description
Constellations	Investigation on the orbital design aimed to minimize control, developed at the time of first large LEO design (Iridium, Globalstar). The know-how gained during the PhD course led as an example to the invitation to the first IAF symposium devoted to constellations, where the study including the original definition of hybrid configurations and recalling passive control techniques exploiting perturbations to acquire slots was presented [C2]
Microsatellite	Participation to the four-members team who designed, built, tested, performed the launch campaign and successfully operated the first Italian University satellite (UNISAT), injected from Baikonur onboard a DNEPR rocket on September 2000. Activities dealt with different subsystems (and test of), sometimes resulting in effective while simple, low cost approaches: [15] reports as an example the analysis of radiation effects. That hands-on experience – even if not so relevant from the point of view of publications - was crucial to understand space applications issues, to evaluate limitations of numerical models and simulations, to appreciate the value of test-beds and experimental activities.
Formation Flying	Born as an evolution of satellite constellations, with the focus on relative dynamics instead of the coverage offered. Along the years, studies included different linear and non linear techniques (like SDRE as an example), for the overall GNC loop, always looking to a correct understanding of the dynamics environment to decrease the required effort. Among sample papers, [14] reports about initial analyses with typical low-altitude perturbations acting, and about changes to include drag effects in a classical LQR scheme, while [2] investigates an attraction/repulsion behavior which would provide a finely tuned control: specifically, the paper shares the interesting geometrical characteristics associated with the (yet-to-be-proven) electrostatic orbital control technique. [10] focuses on the physical meaning of specific, low-control configurations identified by numerical methods, and [6] aims to experimentally investigate the issues of close proximity navigation with an innovative (at the time of publication) yet only bidimensional set-up (today full 3D set-up with Kuka arms are available in a number of labs). A number of publications in the general list report the contributions to several aspects of the formation-flying, including the mission design and the operational aspects, also supported by the cooperation with other research group and the experience as chair for the relevant session at the IEEE Aerospace. A borderline aspect is represented by the comparison between the control effort requested to maintain a close formation and the one for a net where platforms are connected by tethers [A13],[A16],[B17] (tethers studies had indeed a later application in looking at the re-entry of a compound chaser+target spacecraft, approaching the issue of debris removal [2]). On the other hand, the relative control of a number of spacecraft opened the path to swarm studies [9],[B20], a topic planned to be further investigated in the future also with some experimental set-up.

GPS/GNSS	Satellite-based navigation is the most successful example of systems based on a constellation. The interest moved from the optimal design of the space segment to the use of receivers in high dynamics applications (with the authorship of a RTO/NATO AGARDograph on DGPS in Flight Testing, [13]) and then to the use of GNSS as an autonomous navigation sensor in very high orbits. The need to exploit very low SNR calls for software receivers, and performance in missions to the Moon and to Earth-Moon Lagrangian points have been investigated in depth in cooperation with ESA. Among the results, the assessment – in cooperation with Joanneum Research (Graz) - of the suitability of the approach even considering signal outages neglecting the chance to download a complete GNSS data message, and the evidence of performance dependent on the Moon position along the orbit. It is interesting to notice that most of the effort, and the winning bid to ESA, was triggered by 2009 Acta Astronautica paper [12]. A number of follow-up studies are represented by [D90], [D115], [D119].
Filtering	Availability of computational power allows to include estimators in all modern GNC loops to tackle real world disturbances. Starting from classical Kalman approach, the interest moved to UKF, particle and multiple model filters, considered in different aerospace applications [A14],[A18],[A42], while classical, fine-tuned EKF are part of all experimental set-up of the lab.
Floating Platform	PINOCCHIO, a floating Platform Integrating Navigation and Orbital Control Capabilities Hosting Intelligence Onboard which design and operations are pursued at the new Guidance and Navigation Lab since 2010, was deemed to simulate frictionless planar motion. In time, PINOCCHIO enabled a number of experimental studies – always based on the original autonomous platform having 3 degrees of freedom (along the horizontal axis and about the vertical one – i.e. the yaw). The modular avionics allowed to investigate different GNC loops for proximity maneuvers considering inertial and visual sensors, and a simplified star tracker model too. On the other hand, by completing the platform with appendages – and even with a small robotic arm, it was possible to investigate the coupling between structural flexibility or the arm maneuvers and the commanded attitude. To notice that elastic displacements have be sensed with either piezo accelerometes or visual techniques. Publications [4], [5] and [A40-41,43-44,57,73] provide some insight about this research path.
Manipulators	Space manipulators offer a challenging domain to combine the structural dynamics and the GNS skills. Advanced, sound modelling approaches were investigated – also to tackle the inverse kinematic problem which characterizes the multiple link arms - and a number of control schemes – optimal in time or in torque requirements or in the capability to accommodate a poorly know dynamics of the target - were studied and simulated. [7-9], [A28], [D114], [D118], [B22] present the mathematical formulations and discuss some results. [A68] and [A73] attempt initial experimental studies.
Debris Removal	Legacy interest in debris issue ([A1], [B6]) shifted towards removal topics according to the advances in proximity operations and to the growing level of perceived risk. The research has been focussed on the removal of space debris by means of robotic arms, therefore ideally continuing previous topic. According to a specific grant from Astrium, targets of interest were

	identified in spent final stages, orbiting since a long time and with poor knowledge of the resulting structural and inertial properties ([1], [C111] to summarize the contributions). A very interesting aspect is given by the proposed co-simulation approach, where the in-house Matlab code is capable to take into account space environment characteristics and control architecture, while commercial codes as ADAMS – while lacking the space perspective - offer a perfect representation of the mechanical interface at the grasping, including complex and already validated contact forces models. Resulting simulations, clearly a must before any mission could be attempted, have been deemed to attain reasonable confidence.
Visual Navigation	Electro-optical sensors are increasingly appealing due to the improved performance and to the accuracy granted (basically the only suitable for precise proximity operations). Furthermore current computational power availability allows to consider image-based navigation. Starting from a preliminary study [A5] for ATV to ISS rendez-vous (later accepted and continued by ESA) showing the value of Hough-transform based technique, the interest moved to more sophisticated techniques, including feature identification methods as SURF or SIFT. The moderate cost of the equipment allowed to carry on experimental studies with testbeds fed by passive sensors and dedicated to docking or to proximity navigation [5-6], [A40], [A44]. Numerical simulations are applied to consider more complex identification problems as the one represented by a tumbling target [A72]. Future developments are likely to explore the combination of visual and thermal imaging [A52] to overcome limitations of eclipse in LEO in order to provide a really good estimate of the kinematic state of the mating spacecraft and to allow quick operations at the exit from dark. At the same time the option of stereoscopic vision, effective while extremely demanding in computational cost, has been proofed on a small rover [A66], [A71], [D120]

Part VIII – Summary of Scientific Achievements

The full contribution in terms of scientific papers has been reported in the attached "Complete List of Publications", where a possible partition among different categories (fully peer reviewed work, contributions to edited publications, papers accepted and presented to conferences on the basis of the abstracts) has been attempted. According to the original form proposed, relevant global bibliometric parameters are instead reported here, considering both Scopus and the more restrictive Web of Science (WoS) databases.

Docs included (papers)	Database	Start	End
122	Scopus	1994	2017
83	WoS	1993	2017

Total Impact factor	21.31
Total Citations	266 (WoS), 790(Scopus)
Average Citations per Product	3.2 (WoS), 6.48 (Scopus)
Hirsch (H) index	10 (WoS), 15 (Scopus)
Normalized H index*	0.42 (WoS), 0.65 (Scopus)

*H index divided by the academic seniority.

Part IX– Selected Publications

List of the publications selected for the evaluation. As per instructions, each publication report title, authors, reference data, journal IF (if applicable), citations, press/media release (if any). Publications are listed in descending chronological index to highlight as required the contributions of the last 5 years (publications 1-8), and their order corresponds to the label used for the attached documents. Publications, quite aside from the citations received, have been selected in order to represent the global production.

1. "Design of robotic manipulators for orbit removal of spent launchers' stages" (L.Felicetti, A.Pisculli, P.Gasbarri, M..Sabatini, G.B. Palmerini), *Acta Astronautica*, vol.119, pp. 118-130 (2016). IF=1.536, citations WoS 10(8), Scopus 15(13).

2. "Elastic issues and vibration reduction in a tethered deorbiting mission" (M. Sabatini, P. Gasbarri, G.B. Palmerini), *Advances in Space Research*, vol.57, pp. 1951-1964 (2016). IF=1.401, citations WoS 5(4), Scopus 6(5).

3. "Three spacecraft formation control by means of electrostatic forces" (L.Felicetti, G.B.Palmerini), *Aerospace Science and Technology*, vol.48, pp.261-271 (2016). IF=2.057, citations: WoS 1(1), Scopus 2(1).

4. "Delay compensation for controlling flexible space multibodies: Dynamic modeling and experiments" (M.Sabatini, P.Gasbarri, G.B.Palmerini), *Control Engineering Practice*, vol.45 (2015), pp. 147-162. IF=1.83, citations WoS 9 (7), Scopus 11(8).

5. "A testbed for visual based navigation and control during space rendezvous operations" (M.Sabatini, G.B.Palmerini, P.Gasbarri), *Acta Astronautica*, vol.117, pp. 184-196 (2015) IF=1.95, citations WoS 6(4) Scopus 12(7).
   A video reporting the experiment is available at https://www.youtube.com/watch?v=8iyVnfRCh8c

6. "Ground tests for vision based determination and control of formation flying spacecraft trajectories" (P. Gasbarri, M.Sabatini, G.B.Palmerini), *Acta Astronautica*, vol.102, pp. 378-391 (2014). IF=1.122, citations WoS 10(6), Scopus 13(8).

7. "A reaction-null/Jacobian transpose control strategy with gravity gradient compensation for on-orbit space manipulators" (A.Pisculli, L.Felicetti, P.Gasbarri, G.B.Palmerini, M.Sabatini), *Aerospace Science and Technology*, vol.38, pp.30-40 (2014). IF=0.94, citations WoS 15(12), Scopus 23(19).

8. "Deployable Space Manipulator Commanded by means of Visual-Based Guidance and Navigation" (M. Sabatini, R. Monti, P. Gasbarri, G.B. Palmerini), *Acta Astronautica,* vol.83, pp. 27-43 (2013). IF=0.816, citations WoS 15(14), Scopus 27 (23).

9. "Vibration Control of a Flexible Space Manipulator during On Orbit Operations" (M. Sabatini, P. Gasbarri, R. Monti, G.B. Palmerini), *Acta Astronautica*, vol.73, pp. 109-121 (2012). IF=0.701, citations WoS 39(36), Scopus 70 (63).
   This article was longtime listed in the journal website among the five top cited papers recently published.

10. "Minimum Control for Spacecraft Formation in a J2 perturbed environment" (M. Sabatini, D. Izzo, G.B. Palmerini), *Celestial Mechanics and Dynamical Astronomy*, vol.105, pp. 141-157 (2009). IF=0.811, citations WoS 10(7), Scopus 16(8).

11. “Collective Control of Spacecraft Swarms for Space Exploration” (M.Sabatini, G.B. Palmerini), *Celestial Mechanics and Dynamical Astronomy*, vol.105, pp. 229-244 (2009). IF=0.811, WoS 5(5), Scopus 12(7).

12. “En Route to the Moon Using GNSS Signals” (G.B.Palmerini, M.Sabatini, G.Perrotta), *Acta Astronautica,*vol.64, n.4, pp. 467-483 (2009). IF=0.508, citations WoS 9(6), Scopus 19(13).

13. “Differential Global Positioning System (DGPS) for Flight Testing / Global Positioning System Différentiel (DGPS) pour les Essais en Vol” (R.Sabatini, G.B.Palmerini), *AGARDograph 160*, RTO/NATO, Flight Test Instrumentation Series, vol.21, pp.1-182 (2008). AGARDographs are not indexed, citations from Scopus(secondary) are 28(28), and are equal to 45(45) in the GoogleScholar database.

14. “Dynamics and Control of Low-Altitude Formations” (G.B.Palmerini, M.Sabatini), *Acta Astronautica*, Vol.61, No.1-6, pp. 298-311 (2007). IF=0.289, citations WoS 10 (2), Scopus 15(4).

15. "Design of the Radiation Shielding for a Microsatellite" (G.B.Palmerini, F.Pizzirani), *Acta Astronautica*, Vol.50, No.3, pp.159-166 (2002). IF=0.284, citations WoS 1(0), Scopus 5(2).