

**Report on the COSPAR Capacity Building Workshop**  
**" Principles and practices of nano-satellite engineering"**  
**in Tel Aviv, Israel – 28-31 October 2019**

Carlos Gabriel – COSPAR Panel for Capacity Building

### **I – Introduction**

The workshop took place in the Tel Aviv University (TAU) from October 28-31 2019. It preceded the 4<sup>th</sup> COSPAR Symposium on “Small satellites for sustainable Science And Development”, which took place in Herzliya close Tel Aviv, in the following week 4-8 November. Primarily organized by COSPAR, it received support from the Israel Aerospace Industries (IAI), the Tel Aviv University (TAU) and the Herzliya Data Center.

The workshop was proposed and locally organised by Prof. Colin Price (TAU) and Meir Ariel (Herzliya Science Center).

The main objective of the workshop was to introduce young scientists and engineers to the systematic approach on small satellites, cubesats, and space applications, as well as to motivate young students to work on them. Close and extensive contact with experts in the field is the best way to motivate students to develop skills in this direction.

### **II – Participants**

A total of 45 applicants were selected out of a total of around 70 candidates, including 17 local Israeli students. They were from India (13), Turkey (4), Brazil (3), Ethiopia (2), South Korea (2) and 1 each from Nigeria, Switzerland, Russia and USA.

The proportion of local students (almost 40%) was pretty acceptable, the regional character possibilities of a workshop organised in Israel is rather limited for political reasons.

The geographical distribution of the students revealed therefore a wide geographical spread. Gender showed a 57/43 % male/female students distribution. The full list of students including affiliation and nationality is given in Appendix I.

### **III – Workshop characteristics**

The duration of the workshop was shorter than usual, 4 days and 1 day for an excursion to Jerusalem, partly dictated by the extreme high costs of holding a course in Israel. The workshop was mandatory, in association with the Symposium in the following week. Due to the short duration and the difficulties to pursue a practical short course on such a broad theme as nano-satellites, it was more a school than a workshop, with a vast majority of theoretical lectures, and some demonstrations, particularly at the Technion Institute in Haifa, where we have spent the 4<sup>th</sup> day of the course.

### **IV – Venue(s)**

Originally scheduled to happen the first three days at the premises of the IAI, close to Tel Aviv, the school had to be moved to the TAU due to the security restrictions at IAI. As

soon as we knew that several students would not get easily clearance to enter the IAI premises, and one of them (a Palestinian Israeli) not at all, we have rearranged the courses to take mainly place at the Institute for Environmental Studies at TAU. One afternoon we could use a classroom at the Chemistry Institute inside the TAU campus, and a full day (the 4<sup>th</sup>) we had classes and demonstrations at the Technion Institute in Haifa, where several special rooms could be visited.

## V - Lecturers

The list of lecturers including affiliation follows:

Haim Eshed, Chairman, Israel Space Committee
Morris Podolak, Tel Aviv University
Yuval Reuveni, Ariel University
Eyal Ben-Dor, Tel Aviv University
Meir Ariel, Tel Aviv University
Colin Price, Head of Environmental Studies, Tel Aviv University
Noah Brosch, Tel Aviv University
Michal Segal Rosenheimer, Tel Aviv University
Yoav Yair, IDC Herzliya
Shay Zucker, Tel Aviv University
Pini Gurfil, Head of the Asher Space Research Institute, Technion
Igal Kronhaus, Asher Space Research Institute, Technion
Mark Koifman, Lab Chief Engineer, Wind Tunnel Technion
Alex Frid (Technion contact assistant)
Dan G. Blumberg, Ben-Gurion University
Aviran Sadon, Ben-Gurion University
Netanel Levi, Israel Aerospace Industries
Jay Harwood, Israel Aerospace Industries
Natalie Frenkel, Israel Aerospace Industries
Irit fried, Israel Aerospace Industries

As it can be seen, all lecturers were local. All attempts to get some of the international participants of the Symposium to come a week earlier to Israel to teach in the school failed. This could be seen also as a problem, due to the lack of international exposure we want for participants at CB workshops, but alleviated considering the expertise in Israel on Nanosatellites and associated applications and the high level and broad experience in such courses by the people involved.

## VI - Program

The program (Fig. 1) touched a large number of subjects related to the design, build, integration, testing, and usage of nanosatellites. A special accent was put on this last item, with extensive examples from diverse areas, from GPS to astronomy, from remote sensing to Earth Observations. The so-called New Space, a new paradigm for research

and exploration using nanosatellites was largely discussed. The presentations were very motivating, and highly inspiring for many of the participating students.

**Fig. 1 - The program**

Date	Time	Location	
<b>Day 1 Sunday, 27 Oct 2019</b>			Arrival day
	14:00		Check in at "Ana Hostel Tel Aviv"
Date	Time	Location	
<b>Day 2 Monday, 28 Oct 2019</b>	07:00 – 07:45		Breakfast
	8:00		Transportation to Tel Aviv University
	08:30-08:45	Porter Bldg. Room 106	Workshop Opening, Tel Aviv University Colin Price ,Head of Environmental Studies, Tel Aviv University
		Porter Bldg. Room 106	Workshop Opening, Tel Aviv University Meir Ariel, Director of the Tel Aviv University Nano Satellite Center
	09:00-10:30	Porter Bldg. Room 106	Meir Ariel, Tel Aviv University "New Space"
	10:30- 10:45	Porter Bldg. Room 106	Coffee Break
	10:45-12:15	Porter Bldg. Room 106	Colin Price, Head of Environmental Studies, Tel Aviv University "Earth Observations from Space"
	12:15-13:00	Porter Bldg. Room 106	Lunch
	13:00 – 13:50	Porter Bldg. Room 106	Morris Podolak, Tel Aviv University "Using Spacecraft for Planetary Science"
	14:00-14:50	Porter Bldg. Room 106	Yuval Reuveni, Ariel University "Using GPS technology in Earth sciences"
	15:00-15:50	Porter Bldg. Room 106	Eyal Ben-Dor, Tel Aviv University "Hyperspectral remote sensing from space: past, present and future missions"
	16:00-17:30	Porter Bldg. Room 106	"Being young in Israel"
	17:30-18:30		Ice breaker, Porter rooftop cocktail
	18:30		Transportation to the Hostel

Date	Time	Location	
<b>Day 3 Tuesday, 29 Oct 2019</b>	07:00 – 08:00		Breakfast
	08:15		Transportation to Tel Aviv University
	9:00-10:00	Porter Bldg. Room 106	Meir Ariel, Tel Aviv University "Elements of NanoSat Design"
	10:15-11:30	Porter Bldg. Room 106	<del>Netanel Levi, IAI</del> "Physical Principles in the Navigation of the Beresheet Spacecraft"
	11:45-13:00	Porter Bldg. Room 106	Jay Harwood, IAI "Introduction to low earth orbits for satellite communication and observation"
	13:30- 14:30		Lunch
	14:30- 16:15	Porter Bldg. Room 106	Natalie Frenkel, IAI "Nano-Satellite Integration and Testing"
	16:30		Transportation to the Hostel
			Free evening in Tel Aviv
Date	Time	Location	
<b>Day 4 Wednesday, 30 Oct 2019</b>	07:00 – 08:00		Breakfast
	8:15		Transportation to Tel Aviv University
	8:45 - 9:45	Porter Bldg. Room 106	Haim Eshed, Chairman, Israel Space Committee "Israeli Space Program"
	10:00 -11:00	Porter Bldg. Room 106	Noah Brosch, Tel Aviv University "Can we do valuable astronomical observations using cubesats?"
	11:00- 12:00	Porter Bldg. Room 106	Yoav Yair, IDC Herzliya "Observations of transient luminous events (TLEs) from space platforms"
	12:00-13:00	Porter Bldg. Room 106	Michal Segal Rosenheimer, Tel Aviv University "The Earth's Atmospheric composition as seen by Satellites"
	13:00-14:00	Porter Bldg. Room 106	Lunch
	14:00- 14:50	Wolfson Bldg. Room 130	Dan G. Blumberg, Ben-Gurion University "BGUSAT: An Earth observing nanosat"
	14:50- 15:20	Wolfson Bldg. Room 130	<del>Aviran Sadon, Ben-Gurion University</del> "Satellite Attitude Control"
	15:20- 16:20	Wolfson Bldg. Room 130	Shay Zucker, Tel Aviv University "Introduction to Extrasolar Planets"
	16:30		Transportation to the Hostel
Date	Time	Location	
<b>Day 5 Thursday, 31 Oct 2019</b>	07:00 – 08:00		Breakfast
	08:00		Transportation to Technion – Israel Institute of Technology
	10:00-11:00		Wind Tunnel Complex visit
	11:00-13:00		Pini Gurfil: "Nano satellites and the SAMSON Swarm" <del>Igal Kronhaus: "Micro-propulsion Systems"</del>
	13:00- 14:00		Lunch
	14:00- 15:00		Asher Space Research Institute visit (i) SAMSON project - clean room and ground station visit (ii) Distributed Space Systems Lab (DSSL)
	15:00-16:00		Vadim Nudelman - GPS systems & Ballistics Lab
Date	Time	Location	
<b>Day 6 Friday, 1 Nov 2019</b>	9:00- 15:00		Jerusalem Tour / TLV market tour -TBD

## **VII - The visit to Technion in Haifa**

On the fourth day of the workshop, we visited the Technion Institute in Haifa, where in addition to two presentations we had the opportunity to see the Wind Tunnel Complex, a clean room and labs where nanosatellites are built and tested. On the way back, the bus chauffeur stopped at the Bahai Gardens, which we could admire in their full splendour.

## **VIII- Results**

There weren't any student presentations in this school, since there were no individual projects.

## **IX – Accommodation**

All the students and myself were lodged in the Youth Hostel Bnei Dan in Tel Aviv, probably a unique affordable place in a very expensive Tel Aviv. The rooms were of course very simple but comfortable enough, the students share double and triple rooms.

## **X – Breakfast, Lunch, Dinner and Coffee Breaks**

Breakfast and dinner were taken at the Youth Hostel. Mostly simple food according to the place. Coffee breaks with biscuits were served twice per day. Lunch break was also done by a catering service at the Porter Building, except in the day in Haifa, which was very similar, with an assortment of sandwiches and cold dishes.

## **XI – The excursion**

On Friday we had a nice excursion all together to Jerusalem, including several Israeli participants of the school. A very professional tourist guide brought us to the main places in that fascinating city, explained the intricated history along more than 2000 years.

## **XII - General students evaluation**

We prepared and distributed among the students an evaluation sheet (App. II), for getting feedback concerning the different aspects of the workshop, obtaining 12 answered evaluation sheets (a bit more than 25%, but enough to get meaningful results).

There is a general level of satisfaction with the workshop in general, and also with the lecturers and supervisors personally, although the results in this aspect are not as excellent as we are used to in other workshops (surely a result of lecturers just lecturing and not with a close relation as given when sharing hotel and meals). All the answers express satisfaction and the feeling that they benefitted significantly from attending the workshop. However, paying attention to some comments, we see that many of the participants were expecting hands-on activities, as well as an international lecturers team.

The financial support was considered by the students barely sufficient, with a large spread in the opinions. This could be also a consequence of how expensive is Israel at these days.

### **XIII – Personal evaluation**

In my personal view, I consider this event as a good school, very motivating for Engineering and Science students who intend to pursue working in the field of nanosatellites, with excellent (though just local) lecturers showing a lot of experience and a broad sample of applications of the “New Space”. However, a four days course with neither hands-on nor data analysis can be hardly seen as what we understand as Capacity Building.

All in all, though, the atmosphere of friendship during the workshop, the spirit of harmony not only between the students but also between them and the lecturers was the typical one of the CB workshops. A glance of it can be seen in the report written by one of the Indian students (title page included as Annex III).

Again, we would like to thank all the people (the local organisation committee, especially the extraordinary secretary Mrs. Orly Blumberg, who took care of almost everything in the logistics of the workshop, and the lecturers) and the institutions that have substantially contributed to making possible this event: the Tel Aviv University, particularly the Institute for Environmental Studies and the Herzliya Science Data Center, and the Israel Aerospace Industry.

Carlos Gabriel

## Appendix I - List of participants

#	Given Name	Family Name	Gender	Country	Current position
1	Jenny Carolina	Robledo Asencio	Female	Brazil	Postgraduate student
2	Felipe	Oliveira Tavares	Male	Brazil	Postgraduate student
3	Toyese Tunde	Ayorinde	Male	Brazil	Postgraduate student
4	Alemayehu	Cherkos	Male	Ethiopia	Postgraduate student
5	Abraha	Gebremedhn	Male	Ethiopia	Researcher
6	Athira Ajayakumar	Kullully	Female	India	Undergraduate student
7	Nikhil	Riyaz	Male	India	Researcher
8	Sharad Chandra	Tripathi	Male	India	Researcher
9	Shyam	S	Male	India	Undergraduate student
10	Gavani Vamshi Saini	Gavani	Male	India	Undergraduate student
11	Sanketh S	Huddar	Male	India	Undergraduate student
12	Chesler	Thomas	Male	India	Undergraduate student
13	U R Nikhil	Bhat	Male	India	Undergraduate student
14	Aishwerya	Gahlot	Female	India	Undergraduate student
15	Shreyas Jayantilal	Charola	Male	India	Postgraduate student
16	Yaspy J C	Chandrasekaran	Female	India	Postgraduate student
17	Deeksha	Navlani	Female	India	Undergraduate student
18	KUNAL	GARG	Male	India	Undergraduate student
19	melody	Korman Shadmi	Female	Israel	Undergraduate student
20	Shir	David	Female	Israel	Undergraduate student
21	Shelly	Almoznino	Female	Israel	Undergraduate student
22	Josue	Cardoso dos Santos	Male	Israel	Post-doc
23	Vadim	Holodovsky	Male	Israel	Researcher
24	Ariel	Darmon	Male	Israel	Undergraduate student
25	Dekel	Shahar	Male	Israel	Undergraduate student
26	yarden	levenerg	Male	Israel	Undergraduate student
27	Alex	Frid	Male	Israel	Post-doc
28	Tomer	Nahum	Male	Israel	Postgraduate student
29	Yael	Harpaz	Female	Israel	Postgraduate student
30	Omar Alfarooq	obidieh	Male	Israel	Postgraduate student
31	Eyal	Shapiro	Male	Israel	Undergraduate student
32	Yoel	Sanders	Male	Israel	Postgraduate student
33	Shenhav	Lazarovich	Female	Israel	Postgraduate student
34	Yaron	Oz	Male	israel	Researcher
35	Ifat	Tsabari	Female	Israel	Postgraduate student
36	David	Edet	Male	Nigeria	Postgraduate student
37	Ksenia	Osipova	Female	Russia	Undergraduate student
38	Alexander	Frias	Male	South Korea	Post-doc
39	Taeyoung	Kim	Male	South Korea	Postgraduate student
40	Kangkang	Chen	Male	Switzerland	Postgraduate student
41	Erhan	Ergun	Male	Turkey	Researcher
42	Abdullah	Kalkan	Male	Turkey	Undergraduate student
43	Onur	Karaaslan	Male	Turkey	Undergraduate student
44	Gizay	Kisa	Female	Turkey	Researcher
45	M. Chantale	Damas	Female	United States	Researcher

## Appendix II - Results from the evaluation form

### 37th COSPAR Capacity-building workshop, Tel Aviv, Israel (2019)

#### Workshop Evaluation Form

##### General

	5	4	3	2	1	
The website told me all I needed to know about the workshop	4	6	2	0	0	5=strongly agree
The application form was easy to fill in	10	2	0	0	0	4=agree
Applications were efficiently handled	7	5	0	0	0	3=no strong feeling
I had time enough to make my travel arrangements	5	5	0	0	0	2=disagree
The financial support I got was sufficient	2	3	4	1	0	1=strongly disagree

##### Comments

	5	4	3	2	1	
<b>Science Lectures</b>						5=strongly agree
These lectures were for me personally the most useful part of	4	3	2	1	0	4=agree
The time spent on the lectures was too long	2	3	1	1	1	3=no strong feeling
Or the time spent on the lectures was too short	0	0	0	1	1	2=disagree
Or the time spent on the lectures was just right	3	1	0	0	0	1=strongly disagree
The lectures were at too high a level	1	0	1	1	1	
Or the lectures were at too low a level	0	0	0	2	1	
Or the lectures were just right	5	3	1	0	0	
The lectures were well presented	6	5	1	0	0	
The lectures were stimulating	5	7	0	0	0	
The lecturers responded well to questions	5	6	1	0	0	
I found it easy to get on with the lecturers	6	5	1	0	0	
The lecture room was comfortable	7	4	1	0	0	

##### Comments

##### Were there any other topics you would have found especially useful?

Few lectures are very much related to my PhD topic where i can contact to professor and talk about current research.

I would like to suggest to add some time for "hands on" experience.

Not enough practical work

the capacity building part should be the most interesting part, but it's a pity this time, we didn't manage to do it.

I would've liked a few topics explaining the details of attitude determination and control of satellites.

Following Lectures were quite interesting: Earth Observations for Space by Dr. Colin Price, Hyperspectral Remote Sensing from Space by Dr.

Eyal Ben Dor, Observations of Transient Luminous Events by Dr. Yoav Yair

Micro Electronics design of the Nano Satellite in details.

##### Other comments?

practical lectures are needed, and also round tables with professionals

	5	4	3	2	1	
<b>Technical Lectures</b>						5=strongly agree
These lectures were for me personally the most useful part of	5	5	1	0	0	4=agree
The time spent on the lectures was too long	1	2	1	1	2	3=no strong feeling
Or the time spent on the lectures was too short	1	1	0	1	1	2=disagree
Or the time spent on the lectures was just right	2	2	1	0	0	1=strongly disagree
The lectures were at too high a level	0	0	1	1	1	
Or the lectures were at too low a level	0	0	0	1	1	
Or the lectures were just right	7	3	1	0	0	
The lectures were intelligible	7	3	1	0	1	
The lectures were well presented	7	5	0	0	0	
The lectures were stimulating	7	3	2	0	0	
The lecturers responded well to questions	5	6	1	0	0	
I found it easy to get on with the lecturers	5	7	0	0	0	

##### Comments

in my opinion, some of the subjects of the lectures repeated themselves, for instance, the thachnical features of the Nano Sats.

Nano Satellite Integration and Testing by Natalie Frenkel was quite interesting and informative.

This organization was above my expectations in technical matters.Thank you so

	5	4	3	2	1	
<b>Technion Lectures</b>						5=strongly agree
These lectures were for me personally the most useful part of	7	1	3	0	0	4=agree
The time spent on the lectures was too long	2	1	0	1	2	3=no strong feeling
Or the time spent on the lectures was too short	0	0	0	1	1	2=disagree
Or the time spent on the lectures was just right	5	3	0	0	0	1=strongly disagree
The lectures were at too high a level	0	0	2	1	1	
Or the lectures were at too low a level	0	1	0	1	1	
Or the lectures were just right	5	3	1	0	0	
The lectures were intelligible	7	3	0	0	2	
The lectures were well presented	5	7	0	0	0	
The lectures were stimulating	5	7	0	0	0	
The lecturers responded well to questions	5	5	2	0	0	
I found it easy to get on with the lecturers	7	5	0	0	0	



### Comments

Lecture by Dr. Igal Kronhous on Electric Propulsion System was quite interesting.

	5	4	3	2	1	5=strongly agree 4=agree 3=no strong feeling 2=disagree 1=strongly disagree
<b>Accommodation and Venue</b>						
The airport transport was efficiently done	1	1	5	1	1	
The transport to Tel Aviv was efficiently done	3	5	0	1	0	
The rooms at the Guest Hostel were good	4	5	0	0	0	
The food at the Hostall was good	8	1	0	0	0	
The breakfast at the Hostal was good	7	2	0	0	0	
The lunch food at the University was good	6	2	2	1	0	
Generally, the accomodation environment was good	7	3	0	0	0	
The TAU was a good place to hold this workshop	9	2	0	0	0	
The internet connection was acceptable	7	3	1	0	0	
The excursion to Technion at Haifa was good	8	2	0	0	0	
The excursion to Jerusalem was good	8	1	1	0	0	

### Comments

Overall it was quite good. But as a group of participants we had a meal and internet problems. The excursion was so short time.

	5	4	3	2	1	5=strongly agree 4=agree 3=no strong feeling
<b>The Future</b>						
if workshop will be hands on. It will be wonderful apportionment for us.						
I have benefitted significantly from attending the workshop	8	3	0	0	0	

### General Comments (on anything whatever to do with the workshop)

if workshop will be hands on. It will be wonderful apportionment for us  
Was excelent, very good organization, I learend a lot durring the workshop! And of course enjoyed it.  
Again - much needed work and practical learning, lab preparation and team study (round tables).

Hope to invited also some lecturers from USA or European professors, not only the native speakers.  
It can be made much more interactive with small problem analysis during the workshop.  
I like to say a big thank you to the organising committe, the work shop program was an eye opening for me, toward Nano Satellite and Implementation, however these capacity building training has enable me find a research interest to pursue my career in the area of Nano  
I thank COSPAR for the immeasurable opportunity I had to attend this worshop.  
I think COSPAR Workshop very great organisation. I suggest that workshops can become more educational.



# REPORT ON “COSPAR – NANO-SATELLITE CAPACITY BUILDING WORKSHOP 2019”



**Six days workshop on Nano-Satellite at Tel Aviv University, Israel  
(From: 27th October to 1st Nov, 2019)**