

Concepts and Conclusions from the “2010 Pan-American Advanced Studies Institute on Dynamics and Control of Manned and Unmanned Marine Vehicles”

Conceptos y conclusiones de la “Sesión 2010 del Instituto Panamericano de Estudios Avanzados en Dinámica y Control de Vehículos Marinos tripulados y no tripulados”

Leigh McCue¹
Marco Sanjuan²
Ryan Hubbard³

Abstract

In the summer of 2010, the first ever NSF’s Pan-American Advanced Studies Institute (PASI) in Colombia was held in Barranquilla and Cartagena. The two-week institute brought together researchers of the Americas to discuss topics related to dynamics and control of manned and unmanned marine vehicles. This paper presents a summary of the program organization and findings, along with lecturer and participant feedback. It is intended to serve as a lead-in to the technical papers by PASI participants contained in this special edition of *Ship Science & Technology*.

Key words: PASI, marine vehicles, autonomous, unmanned.

Resumen

Entre los meses de Junio y Julio de 2010 se realizó por primera vez en Colombia el Instituto Panamericano de Estudios Avanzados (PASI, del inglés *Pan-American Advanced Studies Institute*) de la *National Science Foundation* (NSF), en las ciudades de Barranquilla y Cartagena. Este instituto a lo largo de dos semanas congregó a investigadores de todo el continente para discutir temáticas relacionadas con dinámica y control de vehículos marinos tripulados y no tripulados. Este artículo presenta una síntesis de los principales elementos de dicho instituto, los resultados de la organización del evento, así como la retroalimentación recibida por conferencistas y participantes. Además, este artículo pretende servir como prólogo a artículos técnicos preparados por los participantes del PASI en esta edición especial de Ciencia y Tecnología de Buques.

Palabras claves: PASI, vehículos marinos, autónomos, no tripulados.

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¹ Aerospace and Ocean Engineering, Virginia Tech. e-mail: mccue@vt.edu

² Mechanical Engineering, Universidad del Norte. e-mail: msanjuan@uninorte.edu.co

³ Aerospace and Ocean Engineering, Virginia Tech. e-mail: hubbard7@vt.edu

Introduction

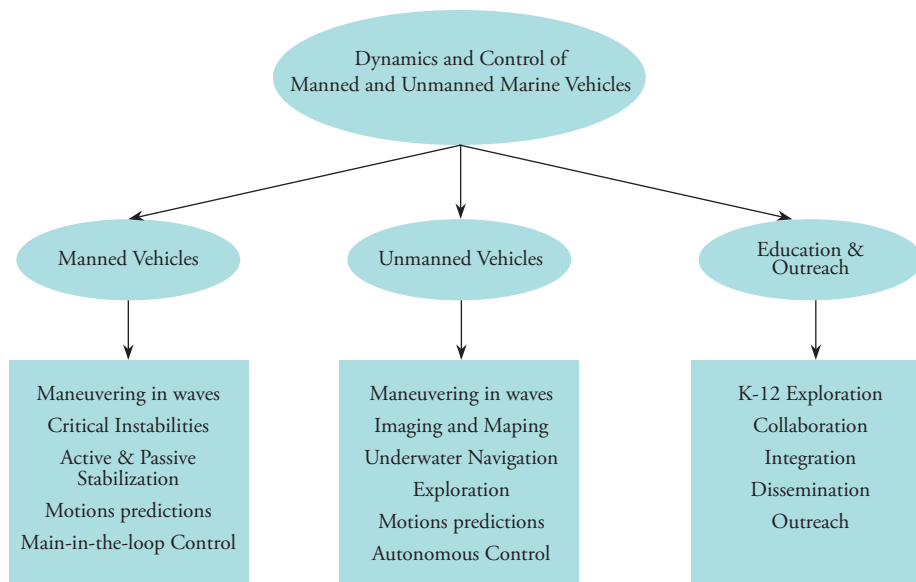
The purpose of the Pan-American Advanced Studies Institute (PASI) on Dynamics and Control of Manned and Unmanned Marine Vehicles was to draw world leaders at controlling, modeling, and predicting the motions of marine vehicles in a unified setting to disseminate knowledge to students, researchers, academics, and practitioners in the Americas. The organization of the Institute represents collaboration between American academics at Virginia Tech and the University of Michigan, Colombian industry and academia including Cotecmar, Universidad del Norte, and Escuela Naval “Almirante Padilla,” and Brazilian faculty at Universidade Federal do Rio de Janeiro. The Institute sought to broaden the base and expertise of researchers, scientists, and students studying dynamics and control as applied to marine vehicles as well to bring together researchers from different sectors of the marine field. By encouraging discussion, education, and collaboration through this Institute, the group collectively formed a stronger collective understanding of the dynamic behavior of vessels in marine environments, control system solutions, as well as the challenges ahead in analytical and computational modeling, design, and control of such vessels. Additionally, the PASI highlighted opportunities for use of unmanned vehicles in K-12

and undergraduate education particularly through SeaPerch (SNAME, 2010) and AUVSI (AUVSI, 2010) opportunities. In Fig. 1 the primary theme areas for the Institute; namely, manned vehicles, unmanned vehicles, and education and outreach, along with sub-topics are presented. Numerous topics appear at the intersection between manned and unmanned vehicles; one of the missions of this workshop was to encourage discussion between manned and unmanned vehicle researchers.

Program and organization

The PASI on dynamics and control of manned and unmanned marine vehicles was developed to educate graduate students and researchers on modern challenges and solutions to maritime dynamics and controls issues. Additionally, as part of the PASI, new collaborative relationships for researchers in the field of stability and control of marine vehicles throughout the Americas were built while bringing together scholars from traditionally disparate sectors of the maritime field, from exploration, to military and commercial shipping, to unmanned vehicles and robotics, in a single venue. Attendees came from as far north as Michigan, west as Hawaii, south as Brazil, and east as Spain. Substantial emphasis was also placed upon mechanisms for incorporation of

Fig. 1. Theme Areas for PASI on Dynamics and Control of Manned and Unmanned Marine Vehicles



unmanned and autonomous vehicles into K-12 and undergraduate education such as the SeaPerch program and Association for Unmanned Vehicle Systems International (AUVSI) competitions.

Organizing Committees

The membership of the international and local organizing committees is as given in Table 1.

Table 1. International and local organizing committees

International Organizing Committee	Institution	Local Organizing Committee	Institution
Leigh McCue	Virginia Tech	Marco Sanjuan	Universidad del Norte
Marco Sanjuan	Universidad del Norte	Oscar Tascón	Cotecmar
Marcelo Santos Neves	Universidade Federal do Rio de Janeiro	Jorge Carreño	Cotecmar
Oscar Tascón	Cotecmar	Germán García	Escuela Naval "Almirante Padilla"
Armin Troesch	University of Michigan	Fabio Zapata	Escuela Naval "Almirante Padilla"

Program

A schedule of events from the final PASI program appears in Table 2. The program generally sought to focus upon manned vehicles in the first week and unmanned vehicles in the second week with lecturers highlighting overlap and areas for collaboration between researchers operating in either or both of these domains. Participants

attended both weeks of the PASI to ensure cross-pollination of ideas.

Participants also engaged in the design and construction of a SeaPerch underwater vehicle. SeaPerch (SNAME, 2010) is a hands-on underwater robotics program coordinated by the Society of Naval Architects and Marine Engineers (SNAME) under Office of Naval Research (ONR)

Table 2. PASI 2010 Schedule

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday			
Time	June 27	June 28	June 29	June 30	July 1	July 2	July 3			
8:00am-9:45am		Registration, Logistics	McCue	Free	Santos Neves	Epureanu	Free			
9:45am-10:00am			Break		Break	Break				
10:00am-12:00pm	BAQ Airport to Hotel Transportation	Opening ceremony	<i>Nonlinear Dynamics Presentations:</i> Villagomez Rosales, Manuico Vivanco, Piro & Dorger, Sefat; Mod: Caldwell	River Trip	<i>AUV Control Presentations:</i> Caldwell, Andonian, McCarter, Rader"; Mod: Bula	<i>CFD & Naval Architecture Presentations:</i> Bula, Martin, Celis Carbajal, Backlund; Mod: Jones	Barranquilla to Cartagena (2 Stops)			
12:00pm-2:00pm		Lunch			Lunch					
2:00pm-3:45pm		Hansen	Troesch		Sanjuan	Wrap Up 1				
3:45pm-4:00pm		Break	Break		Break	Break				
4:00pm-6:00pm		SeaPerch	SeaPerch		SeaPerch	Brainstorm				
Evening		Free								

Time	July 4	July 5	July 6	July 7	July 8	July 9	July 10
8:00am-9:45am	Free	Registration, Logistics	Tascón	Free	Carreño	Wrap Up 2	CTG Hotel to Airport Transportation
9:45am-10:00am			Break		Break	Break	
10:00am-12:00pm		Woosley	Ordoñez	Shipyards Tour (Cotecmar) Depart Hotel at 9:30 am	Chyba	SeaPerch	
12:00pm-2:00pm		Lunch			Lunch		
2:00pm-3:45pm		Eustice	Neu		Cooper & Nelson	Contreras ENAP vessel demo & SeaPerch Challenge	
3:45pm-4:00pm		Break	Break		Break		
4:00pm-6:00pm	Barbecue	Free	SeaPerch	Free	CFD Presentations: Ubach, Jones, Bloxom, Coe; Mod: Martin		
Evening					Night Tour (Optional)		Free

*Rader presentation moved to July 8

funding. This K-12 outreach activity is designed to introduce students to fundamental concepts in engineering and naval architecture ranging from teamwork to Archimedes’ principle. By having PASI participants build SeaPerch vehicles, the PASI served the dual purpose of essentially becoming an international SeaPerch teacher training session. This emphasis on outreach was a core component of the PASI with talks scheduled to focus on teaching with underwater vehicles.

In addition to the technical lecturers and presentations, available online at the PASI website: <http://www.pasi.aoe.vt.edu>, and SeaPerch activities, highlights of the program included a river trip on a buoy tending vessel along the Rio

Magdalena and a tour of COTECMAR’s shipyard. This allowed participants to have strong exposure to the specific needs and interests of the Colombian commercial and military naval sector. Additional social activities included a scenic tour between Barranquilla and Cartagena with a beachside stop for fish, swimming, and soccer, along the Caribbean at Caño Dulce and experiencing the mud volcano Volcán del Totumo, a holiday barbeque at the Colombian Naval Officers’ Club hosted by COTECMAR, an evening chiva tour of Cartagena, and a free-day to sightsee. A brief pictorial summary is given in Fig. 2.

During the institute, the usage of surface and semi-submersible small vessels for drug trafficking from

Fig. 2a. Participants and lecturers aboard a buoy tending vessel on the Rio Magdalena



Fig. 2b. The victors from the PASI SeaPerch competition



South American countries to Central and North America was discussed. Thanks to COTECMAR and the Colombian Navy's Coast Guard Station in Cartagena, the participants were briefed on the challenges of this type of activity and the successful interdiction operations of recent years. PASI attendees had the opportunity to take a close look at four indicted vessels stationed in Cartagena's Coast Guard Station.

Fig. 2c. Participants' view of buoy tending

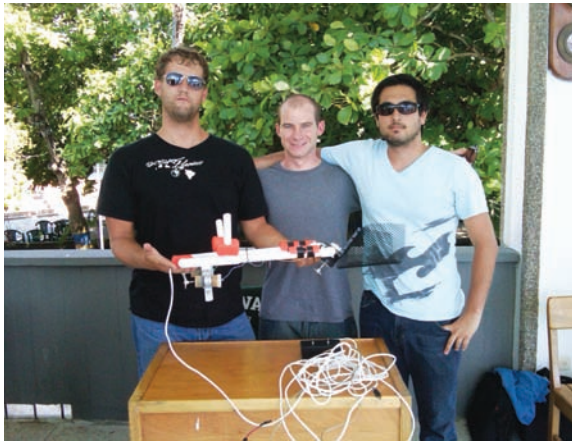


Fig. 2d. PASI participants studying density and viscosity in Volcán del Totumo outside Barranquilla, Colombia



Fig. 2e. PASI participants and lecturers at the Cotecmar Mamonal facility



Fig. 2f. Colombian Coast Guard captured semi-submersible



Findings

While full technical details of the presentations are available on the PASI website at <http://www.pasi.aoe.vt.edu>, specific findings included highlighting the interplay between technologies developed for unmanned vehicles as applicable to manned vehicles, sensors, development of traditional and non-traditional computational fluid dynamics approaches for design and control, and the importance of reaching the next generation of young engineers via exciting hands-on outreach activities.

Participant and Lecture Feedback

Feedback from the participants and lecturers of the PASI was needed in order to evaluate the effectiveness of the program. This feedback was collect via a questionnaire-styled survey given to participants and lecturers at the beginning and conclusion of the program. The pre-survey was designed to gather information on demographics, as well as determining what the expectations of the participants and lecturers were before starting the program. The post-survey is designed to see if those expectations were met and if the mission of the PASI program was accomplished. Both surveys were administered in English and Spanish and the format of both surveys is given in Appendices A and B.

Demographics

The PASI program saw a diverse blend of lecturers and participants in terms of citizenship, location of work, and academic level. The demographic distribution of citizenship of the lecturers and participants completing the pre-survey is illustrated in Fig. 3(a), demographic distribution of location of work of the lecturers and participants completing the pre-survey is illustrated in Fig. 3(b), and the academic level of the lecturers and participants completing the pre-survey is illustrated in Fig. 3(c).

Fig. 3a. Pre-survey "In what country do you primarily hold citizenship?"

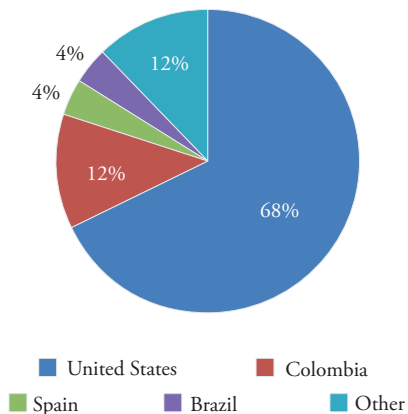


Fig. 3b. Pre-survey "In what country do you primarily works?"

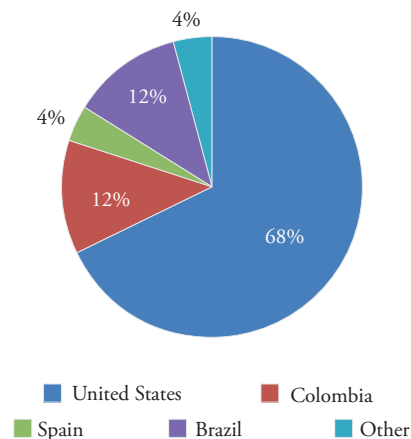
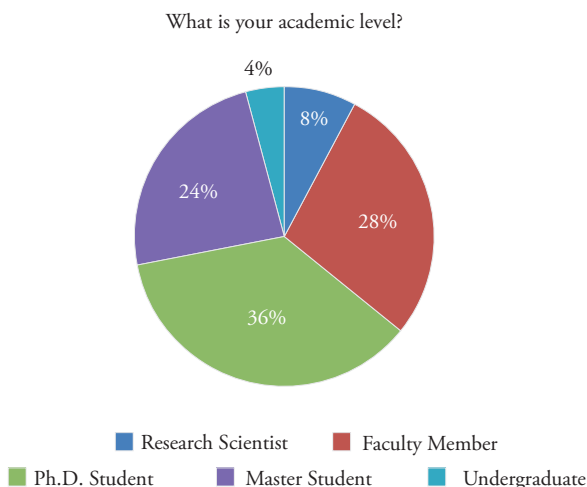


Fig. 3c. Pre-survey "What is your academy level?"



Program evaluation

Based on the pre-program survey, expectations of the lecturers and participants ranged from a desire to learn more about the technologies at hand and on-going research in the field to networking and a seeking to learn more about Colombian culture and foreign engineering methods. In response to the question "What do you expect to gain from participating in PASI," answers included:

"Meet new people. Exchange ideas. Learn something new. Get exposure for my work. See a new country/culture."—*US faculty member*

"Learn about Colombia and manned & unmanned vehicles."—*US masters student*

"Learn about state of the art marine dynamics and controls. Meet people working in the field. Find ideas for collaborative projects in the topic of the PASI"—*Colombian PhD student*

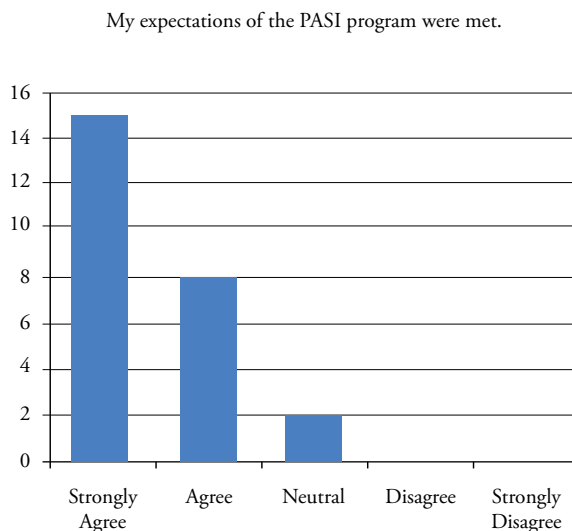
"1) Relationships with colleagues from domestic and international universities who have similar or complementary research interests.

2) A better understanding of the Colombian Navy's challenges, particularly wrt riverine operations. (Riverine USVs are a current research interest.)"—*US faculty member*

"Compartir experiencias y avances en los temas centrales del PASI. Conocer colegas de otros países y generar redes"—*Masters student studying in Brazil*

Participants and lecturers were asked in the post-survey questionnaire whether or not their expectations from the beginning of the program were met, the results of which are presented in Fig. 4. Based on the responses they gave prior to the start of the program, participants and lecturers could indicate whether they strongly agreed,

Fig. 4. Post-survey Respondents' Feedback on Expectations



agreed, felt neutral, disagreed, or strongly disagreed that their expectations of the PASI event were met. From the results, it is apparent that a vast majority of respondents felt that what they sought to gain from PASI was achieved.

An effective method to assess whether the program accomplished its mission was to directly ask the students and lecturers in attendance. Two of the main goals of the PASI program involved disseminating scientific and engineering knowledge as well as uniting researchers from the Americas to stimulate cooperation and training (NSF, 2010). Figs. 5(a) and 5(b) show the degree to which the respondents felt this was accomplished.

Fig. 5a. Post-Survey Respondents' Assessment of Knowledge Dispersal

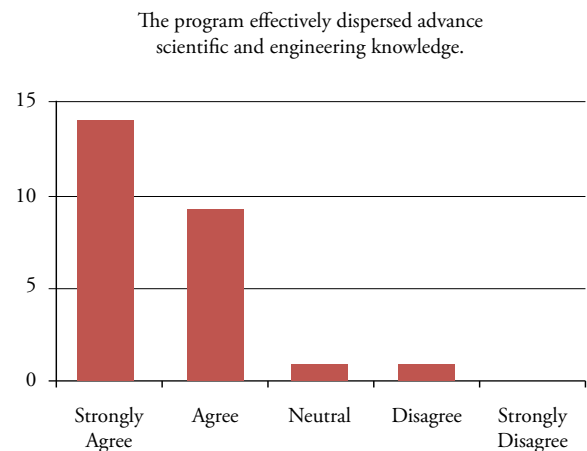
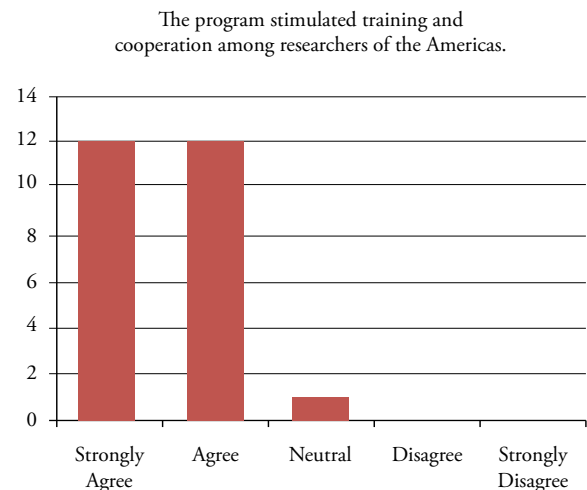


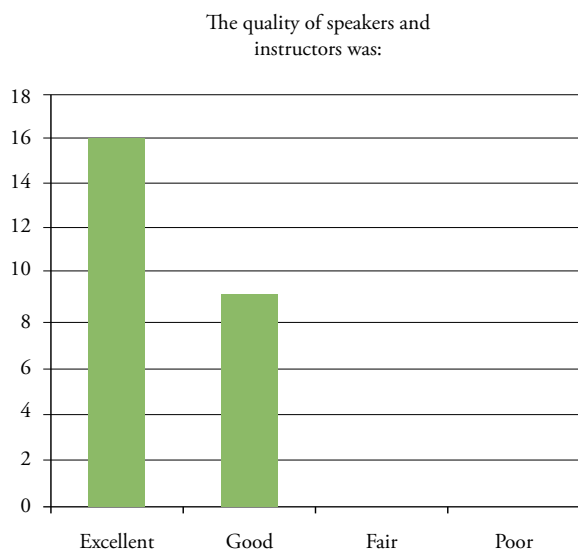
Fig. 5b. Post-Survey Respondents' Assessment of Training and Cooperation Stimulation



As indicated, an overwhelming majority of the respondents either agreed or strongly agreed that the goals of PASI were met, speaking to the overall effectiveness of the program.

In addition, participants and lecturers were also asked to evaluate the quality of the conference speakers. Fig. 6 shows that all respondents felt the instructors were either excellent or good.

Fig. 6. Post-Survey Respondents' Opinion of Speaker and Instructor Quality.



Program evaluation

On the post-survey, lecturers and participants were also asked to suggest areas of improvement for future PASI-like gatherings of scientists and engineers. Many respondents expressed that they were happy with the way the program was executed, though some made suggestions to reduce the overall length of the program.

There were also some respondents that expressed a desire to have more group work present during the sessions. Group work in the PASI as scheduled was limited to end-of-week wrap up sessions and the SeaPerch hands-on outreach activity. While long lunches were scheduled deliberately to allow time for individual interaction, structuring this into 'active learning' exercises in each session certainly makes sense in the context of learning theory, is

highly feasible, and would be a welcome addition to any PASI program.

In response to the question "Do you have any suggestions for improvements of the program?" answers included:

"Shorter lectures and more group work. For example, each lecturer could provide short (~30 minutes) activity for participants to work on after each lecture. Participants would be encouraged to work with different groups every day."—*US PhD student.*

"The mix of technical and personal interaction is ideal to encourage collaboration among the participants"—*US faculty member.*

"Very effective as is. My expectations were different but then I realized how naive I was in these, and learned a lot. Was a significant 'eye opener' for me regarding issues, the military situation, and required technologies well beyond my previous assumptions. Moreover, meeting the various parties, NAVY, CG, etc, face-face in their facilities was far more effective than meeting them in the US.

Improvements: possibly some side-bar meetings + time with principles to discuss business; or not...*i.e.* prior development of gaps & issues (CUT TO CHASE) and technologies on the other side; bring together in a form of applicability. Prior to program, identify and initiate POCs state-side for possible business + funding routes=do this up front prior to travel so 'follow-up' is clear and pre-initiated. Follow-up is usually what fails to happen with these conferences."—*US research scientist.*

"The overall program was good and there was a variety of different marine vehicle presentations. It was well organized but perhaps a little smaller of an event than I expected. The Colombian hosts did a great job at making the participants comfortable and entertained. More students would be

nice because we have the most to gain from this experience. Overall, I had a fantastic trip!"—*US masters student.*

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The authors are also tremendously grateful to everyone who assisted on the organizing committees and in the nitty-gritty making the program happen

details including Maria Claudia Durango Dickson (UniNorte), Ely Acosta (UniNorte), Rosa Avalos (VT), Jon Couch (VT), CMDR Oscar Tascón (Cotecmar), CAPT Jorge Carreño (Cotecmar), Fernando Delgado (Cotecmar), Carlos Mojica (Cotecmar), Luis Aranibar (Cotecmar), Jimmy Saravia (Cotecmar), CMDR Fabio Zapata (Escuela Naval), Germán García (Escuela Naval), ADM Luis Ordoñez (Escuela Naval), Marcelo Santos Neves (UFRJ) and Armin Troesch (UM). And last, but certainly not least, the authors wish to thank the wonderful lecturers and participants, without whom this PASI never would have happened.

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Appendix A: Pre-survey



English

Español

1. In what country do you primarily hold citizenship?

- a) Argentina
- b) Brazil
- c) Colombia
- d) Spain
- e) United States
- f) Other

1. ¿En qué país tiene ciudadanía?

- a) Argentina
- b) Brasil
- c) Colombia
- d) España
- e) Estados Unidos
- f) Otros

2. In what country do you primarily work?

- a) Argentina
- b) Brazil
- c) Colombia
- d) Spain
- e) United States
- f) Other

2. ¿En qué país trabaja primariamente?

- a) Argentina
- b) Brasil
- c) Colombia
- d) España
- e) Estados Unidos
- f) Otros

3. What is your gender?

- a) Male
- b) Female

3. ¿Cuál es su género?

- a) Masculino
- b) Femenino

4. What is your academic level?

- a) Ph.D Student
- b) Masters Student
- c) Undergrad Student
- d) Faculty Member
- e) Research Scientist

4. ¿Cuál es su nivel académico?

- a) Estudiante de Ph.D.
- b) Estudiante de Maestría
- c) Estudiante Universitario
- d) Miembro de facultad
- e) Científico de investigaciones

5. What do you expect to gain from participating in PASI?

5. ¿Qué espera obtener al participar en PASI?

Appendix B: Post-survey (English)



English

1. In what country do you primarily hold citizenship?

- a) Argentina
- b) Brazil
- c) Colombia
- d) Spain
- e) United States
- f) Other

2. In what country do you primarily work?

- a) Argentina
- b) Brazil
- c) Colombia
- d) Spain
- e) United States
- f) Other

3. What is your gender?

- a) Male
- b) Female

4. What is your academic level?

- a) Ph.D Student
- b) Masters Student
- c) Undergrad Student
- d) Faculty Member
- e) Research Scientist

5. My expectations of the PASI program were met.

- a) Strongly Disagree
- b) Disagree
- c) Neutral
- d) Agree
- e) Strongly Agree

6. The program effectively dispersed advanced scientific and engineering knowledge.

- a) Strongly Disagree
- b) Disagree

- c) Neutral
- d) Agree
- e) Strongly Agree

7. The program stimulated training and cooperation among researchers of the Americas.

- a) Strongly Disagree
- b) Disagree
- c) Neutral
- d) Agree
- e) Strongly Agree

8. The quality of speakers and instructors was:

- a) Excellent
- b) Good
- c) Fair
- d) Poor

9. The quality of the facilities and equipment used in Barranquilla was:

- a) Excellent
- b) Good
- c) Fair
- d) Poor

10. The quality of the facilities and equipment used in Cartagena was:

- a) Excellent
- b) Good
- c) Fair
- d) Poor

11. Do you have any suggestions for improvements of the program? (fill in below)

Appendix B: Post-survey (Español)



Español

1. ¿En qué país tiene ciudadanía?

- a) Argentina
- b) Brasil
- c) Colombia
- d) España
- e) Estados Unidos
- f) Otros

- c) Neutral
- d) De acuerdo
- e) Totalmente de acuerdo

2. ¿En qué país primariamente trabaja?

- a) Argentina
- b) Brasil
- c) Colombia
- d) España
- e) Estados Unidos
- f) Otros

7. El programa estimuló la preparación y cooperación de investigadores de las Américas.

- a) Totalmente en desacuerdo
- b) En desacuerdo
- c) Neutral
- d) De acuerdo
- e) Totalmente de acuerdo

3. ¿Cuál es su género?

- a) Masculino
- b) Femenino

8. La calidad de los oradores e instructores fue:

- a) Excelente
- b) Buena
- c) Regular
- d) Mala

4. ¿Cuál es su nivel académico?

- a) Estudiante de Ph.D.
- b) Estudiante de Maestría
- c) Estudiante Universitario
- d) Miembro de facultad
- e) Científico de investigaciones

9. La calidad de las instalaciones y equipo usado en Barranquilla fue:

- a) Excelente
- b) Buena
- c) Regular
- d) Mala

5. Mis expectativas del programa PASI se cumplieron

- a) Totalmente en desacuerdo
- b) En desacuerdo
- c) Neutral
- d) De acuerdo
- e) Totalmente de acuerdo

10. La calidad de las instalaciones y equipo en Cartagena fue:

- a) Excelente
- b) Buena
- c) Regular
- d) Mala

6. El programa difundió efectivamente conocimientos científicos y de ingeniería avanzados.

- a) Totalmente en desacuerdo
- b) En desacuerdo

11. ¿Tiene algunas sugerencias para poder mejorar el programa? (Llene abajo)
