

出國報告（出國類別：國際會議）

出席「2007年水下技術與海底電纜科學觀測使用技術」國際研討會

服務機關：交通部中央氣象局地震測報中心

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出國期間：96年4月16日至96年4月21日

報告日期：96年7月5日

## 摘要

參與這次在日本東京舉行的水下技術與海底電纜科學觀測使用技術國際會議，其最主要目的是希望透過會議參與意見交流的方式，快速獲取海纜觀測系統建置最新技術發展的資訊，以利本局「台灣東部海域電纜式海底地震儀及海洋物理觀測系統建置計畫」之執行。以下即就參與這次國際會議所汲取之經驗做一簡單之彙整：（1）針對災害預防與科學研究之需要，許多國家或聯盟紛紛進行海底電纜式觀測系統的建置計畫，例如日本、美國、加拿大、韓國、歐盟以及台灣等；（2）國際上進行海纜觀測系統建置的各國皆有優秀之學術界專家學者組成顧問團隊給予相關支援，建議媽祖計畫亦應成立國內學術界各相關領域專業人員所組成的科學顧問團，適時提供各項技術支援；（3）有關嵌入式或節點式海纜觀測系統之選擇，嵌入式系統成熟、費用較低但擴充性小，節點式系統雖費用較高但具有較大擴充性，兩者各有優劣，宜多方評估；（4）海底電纜觀測系統建置所需的經費相當龐大，媽祖計畫必須儘快釐清可用經費之額度，方能有效確定系統施做之方式與時程；（5）可以透過各種管道進行宣傳，例如文宣、網頁、辦理相關說明會等，使相關領域專業人員或社會大眾對計畫的執行能有更多的認識與瞭解；（6）國際研討會是快速獲取最新技術資訊非常好的場所，因此建議本局可以適時在國內舉辦國際研討會，邀請國際上的專家至國內報告與交流。

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## 一、目的

中央氣象局自民國 96 年起執行「台灣東部海域電纜式海底地震儀及海洋物理觀測系統建置計畫」，預計利用 3 年時間在台灣東部海域建置電纜式海底地震儀及海洋物理的觀測系統，該計畫初步命名為媽祖計畫（Marine Cable Hosted Observatory，簡稱MACHO），取其諧音代表媽祖保佑祈福之民間習俗。根據計畫內容，海底光纖電纜由宜蘭頭城向外海延伸（圖 1.1），長度約 250 公里，沿線規劃設置 4 個觀測節點（Node），每個節點裝置地震儀、海嘯計與溫度計，地震儀則包括速度型地震儀、寬頻地震儀以及加速度型震儀，並可以在未來延伸裝設不同科學觀測儀器，例如利用遠端操控載具（Remotely Operated Vehicle，簡稱ROV）裝設深海攝影機、傾斜儀或洋流計等。建置時程從 2007 至 2009 年，完成後將評估繼續以此觀測系統為基礎，向後延伸其長度，並在最後拉回頭城形成一環狀的電纜式觀測系統。該計畫之預期效益包括：

- （一）有效提高台灣現有陸上地震觀測網的涵蓋範圍至延伸海域，可以提供較正確且即時的地震資訊，增加地震預警及防災作用。
- （二）海底電纜裝設海嘯監測儀器可以有效掌控近海區域海嘯的訊息，做為海嘯預警的功用。
- （三）台灣東部海域電纜式海底地震儀及海洋物理觀測系統建置可以做為多功能的科學研究工具，大幅提升國內地球與海洋科學的研究能力與範疇。

今(96)年 4 月 17 日至 20 日日本東京大規模舉辦「2007 年水下技術與海底電纜科學觀測使用技術國際研討會」（Symposium on Underwater Technology 2007 and Workshop on Scientific Use of Submarine Cables & Related Technologies 2007）（圖 1.2），主辦單位包括美國電子電機工程師學會（IEEE）及其所屬海洋工程學會（Oceanic Engineering Society，簡稱OES）、日本東京大學生產技術研究所（Institute of Industrial Science，簡稱IIS）以及日本海洋研究開發機構（Japan Agency for Marine-Earth Science and Technology，簡稱JAMSTEC）等單位。OES 長久以來負責全世界海洋相關水下技術之推廣發展，每兩年授權舉辦一次國際研討會，歷年皆於日本東京進行，唯一例外在 2004 年，該次研討會由台灣大學「工程科學與海洋工程學系」於台北「公務員人力中心福華國際文教會館舉辦」。

本屆研討會則擴大規模，與海底電纜科學觀測使用技術結合共同召開，假日本東京大學的生產技術研究所舉行，主要與會者包括美、法、日、台、韓、德、新加坡與義大利等各國相關學者與廠商共計 200 多人，發表的論文超過 100 篇（報告論文資料請參考附錄），對於水下觀測與聯合布網的現況與未來發展方向有非常詳細及深入的探討。

由於會中發表多篇海底電纜於地震海嘯觀測相關的技術報告，因此職奉派參與本次的國際研討會，主要目的是要藉由聽取珍貴專業技術報告，以及主動跟與會學者的交流，獲取國際上最新技術發展的資訊，對於本局自今年開始執行的媽祖計畫，在技術的諮詢以及規格的研擬上，將可提供立即的幫助。

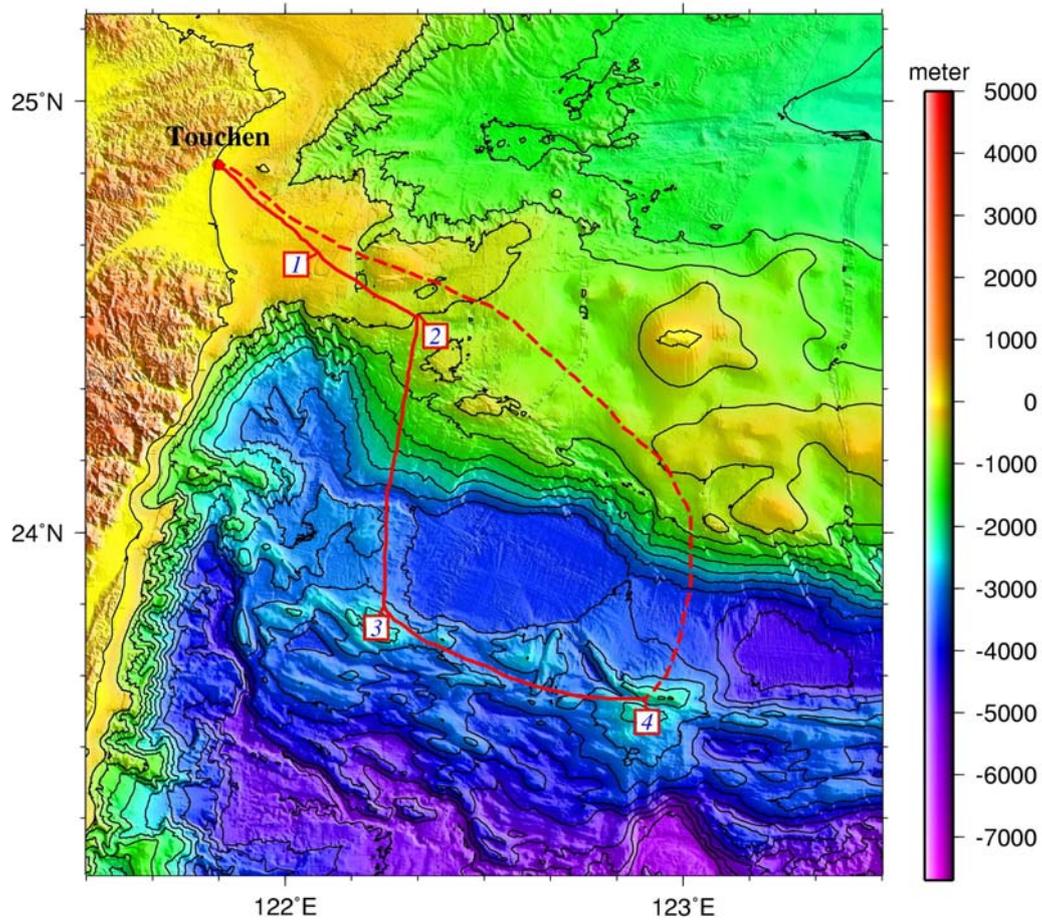


圖 1.1、媽祖計畫 (MACHO) 建置構想圖。紅色實線代表第 1 期 3 年預計建置的海底電纜線路徑，方框代表預計建立的 4 個節點，紅色虛線則代表第 2 期預計建置的海底電纜線路徑。

IEEE Catalog Number: 07EX1770C  
ISBN: 1-4244-1208-0  
Library of Congress: 2007924332

# International Symposium on Underwater Technology 2007

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“ Advanced Underwater Technology for the Ocean ”

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### SEIKEN SYMPOSIUM No.49



圖 1.2、「2007 年水下技術與海底電纜科學觀測使用技術國際研討會」宣傳海報，  
資料摘自 [http://seasat.iis.u-tokyo.ac.jp/ut07\\_SSC07/AP\\_UT07\\_SSC07.pdf](http://seasat.iis.u-tokyo.ac.jp/ut07_SSC07/AP_UT07_SSC07.pdf)。

## 二、過程

職於今(96)年4月16日搭乘下午2點20分華航CI018班次的飛機赴日，同行者尚包括本中心呂佩玲副主任、何美儀課長以及林祖慰技士等共4人，晚上6時許抵達日本東京成田機場後，直接搭乘巴士到下榻飯店入住，整理會議相關資料。東京當地天氣的氣溫低於10°C以下並偶有陣雨，根據1週氣象預報，會議進行期間有半數為多雲時雨的天氣，不過除了首日技術參訪行程稍受影響外，其餘室內議程如期進行。

4月17日第1天議程，依照歷年往例，主辦單位安排技術參訪，本屆安排前往東京東南方面臨太平洋的鎌倉(Kamakura)，參觀鶴岡八幡宮(Tsurugaoka Hachimangu Shrine)、鎌倉大佛(Great Buddha Statue)與新江之島水族館(Shin-Enoshima Aquarium)等地方，但因為行程有人數限制，且與本中心業務並無直接關聯性，故另外規劃自行前往東京消防廳位於東京橫川的本所防災館(Life Safety Learning Center)參觀(圖2.1及圖2.2)。本所防災館於1995年4月27日成立，主要提供各式自然災害的體驗學習訓練，包括地震、暴風雨、煙霧、滅火與緊急救難體驗等，另有防災知識推廣與查詢服務，與本局多項業務相當接近；除此之外，該館尚有立體映像宣導短片，假想東京地區發生震度6強地震時，模擬各種行業遭逢強震之建議處理程序，三維映像帶給觀眾逼真震撼的模擬感受。此類免費體驗學習模式，易深入普及各階層學生與一般社會大眾，可做為未來台灣改進地震防災宣導訓練的參考。

4月18日第2天議程(議程資料請參考附錄)，早上9點前即抵達會場，完成報到手續並領取大會資料與註冊證明，大會於報到處兩旁空間，已備妥海報展覽區與廠商儀器展示空間(圖2.3至2.5)。正式開幕共準備兩場邀請演講，首先由美國華盛頓大學的Delaney教授介紹美加兩國共同合作進行之海神計畫(North-East Pacific Time-series Undersea Networked Experiment，簡稱NEPTUNE)，詳細描述此計畫的相關起源、規劃、執行情形與未來可供應用的願景與展望，內容深入淺出且動態圖片精美，彷彿欣賞1場巨資打造的聲光電影。第2場則由日本東京大學Ura教授介紹無人機動載具(Autonomous Underwater Vehicle，簡稱AUV)於印度洋中間的中洋脊谷潛水觀測熔岩活動的

相關技術與成果，如此技術實著令人驚嘆且印象深刻；附帶一提，該載具編號為r2D4，暗示與電影「星際大戰」之關聯，結合海神、火星與金星計畫等，皆反映水下技術常應用天文或科幻之名。

兩場邀請演講結束之後，大會親切地安排所有與會學者合照，拍照地點為生產技術研究所前方大草坪，因為人數眾多且無適當階梯狀舞台，故採行列式排列，眾人集體引頸向上觀望，大會工作人員直接由 3 樓俯視拍攝完成大合照（圖 2.6）。

經短暫茶點休息時間，研討會口頭報告正式展開，首先由水下載具技術成果與聲學傳遞觀測網兩大領域揭開序幕，另有海底地形工程、聲波記錄與辨識、聲納技術與水深探測以及網連化觀測系統技術接續登場。目前世界商業市場中，主要用於深海採樣或裝置架設維護的 ROV 之最深操作水深約為 4,000 公尺，而 JAMESTEC 則將開發操作深度可達 11,000 公尺的 ROV，預期會用於探測世界海洋最深處之馬里亞納海溝。另有一特殊報告，主要利用蠔殼與砂的混合物進行水下土壤改善工程，以強化港口設施或沿海地形，或許台灣西南沿海遭遇嚴重地層下陷問題之地區可以考慮引用該項技術。

網連化觀測系統技術是此行關注的重要主題之一，依序聆聽美加合作之海神計畫（NEPTUNE）、日本地震海嘯海床密集觀測網系統（Dense Oceanfloor Network System for Earthquake and Tsunamis，簡稱DONET）以及歐洲海床觀測網（The European Sea Floor Observatory Network，簡稱ESONET）等各國主要系統介紹，可以充分提供媽祖計畫所需要的組織架構、經費估算、時程規劃與系統建置等各步驟的參考應用資料。此外，今日論文發表總篇數中，台灣學者所佔比例即超過兩成，其中聲波記錄與辨識全時段更全由台灣學者包辦，由此可見台灣在水下技術工程方面不乏優秀人才，未來若能加以整合並提供足夠經費，台灣海洋研究科技與知識成果應可大幅提升。

4 月 19 日第 3 天議程，繼續邀請 3 位學者進行專題演講，主題包括 11,000 公尺水深之混合式遠端操控載具 ROV 實作、日本水下電纜式觀測網現況與水下現場微射流生化感應探測技術，這些內容部分為首次聽聞，令人大開眼界。至於論文發表部分，主題包括陣列式全球衛星定位系統與精準定位、觀測感應器、新型水下載具與子系統、新網連化觀測系統導述與海底電纜觀測技術應用等項目。定位準確度是水下觀測系統非常重要的關鍵，尤其是對於台灣的地震

與海嘯觀測目的而言，精準的觀測點定位資料是絕對必需的。利用陣列與中繼聲波傳遞等概念可有效協助水下定位，會中有各式新型更省時省力的操作方法介紹，未來應可做有效的運用。

而在新網連化觀測系統導述單元中，汲取相當多新穎的重要資訊，包括各國現有的計畫規模大小、預定時程、預估總經費等等。大體而言，總經費預估在 1 千萬至 1 億美金，折合台幣約 4 至 30 億上下，實際安裝建置時間約 4-5 年，這些數字與概念對於媽祖計畫 (MACHO) 的規劃與執行助益良多。另外，系統設計時需要考慮的備援架構、網狀排列方式與節點共構 (如地震儀、壓力計與其他觀測設備) 等因素，也應一併納入考量。事實上，媽祖計畫除了經費之外，通過地形破碎帶與當地快速移動海潮更是其他國家計畫較少遇到的瓶頸，由此可預期未來施工的困難程度。

海報展覽亦為第 3 天議程的重要項目，這次會議的海報全部都是由學者專家提供，並無納入研究所學生的成果發表，所呈現的內容相對成熟仔細。透過與研究學者本身直接討論互動，可更深入了解目前實際運作情況。尤其是日本在外海進行的多條海底纜線觀測，在海底地形調查、即時海嘯警報、水下現址生化調查 (如 PH 值、錳離子濃度) 與深海直接觀測等領域，都提供很多實作技術，這些都是未來台灣即將實際參與的研究工作。

4 月 20 日是最後 1 天議程，論文主題包括生物擬態載具、海底電纜觀測技術應用、水中滑翔機與流體動力、魚與海洋哺乳動物行為研究與水下載具導航控制等項目，其中絕大部份都是首次接觸的領域，實在難以消化理解更遑論應用，所以主要重心仍在海底電纜之技術應用，諸如海床氣體滲流監測、地震海嘯觀測系統建置、水下現址錳離子濃度監測以及油氣探測等等。

綜合言之，這次於日本東京大學生產技術研究所舉辦的國際研討會，相當順利成功。就場地而言，除 5 場專題演講集中於大會議室之外，同時段場次不同領域的論文報告個別安排於不同的會議室 (圖 2.7、2.8) 舉行，各項硬體設備完善良好，而邀請的與會講員，也皆為研究學者或廠商研發專員，除海報展示空間稍小、部份場次因參與踴躍而過於擁擠等小瑕疵之外，可以充分感受到主辦單位的用心，期盼下屆會議再舉辦時，我們也同樣能夠在這個世界性的舞台上，將台灣媽祖計畫的執行成果向世界各國發表。



圖 2.1、筆者（最右者）與本局地震測報中心呂佩玲副主任（最左者）及何美儀課長於本所防災館前攝影留念。



圖 2.2、本所防災館內之地震體驗室。



圖 2.3、大會報到處。



圖 2.4、參展廠商展示空間。

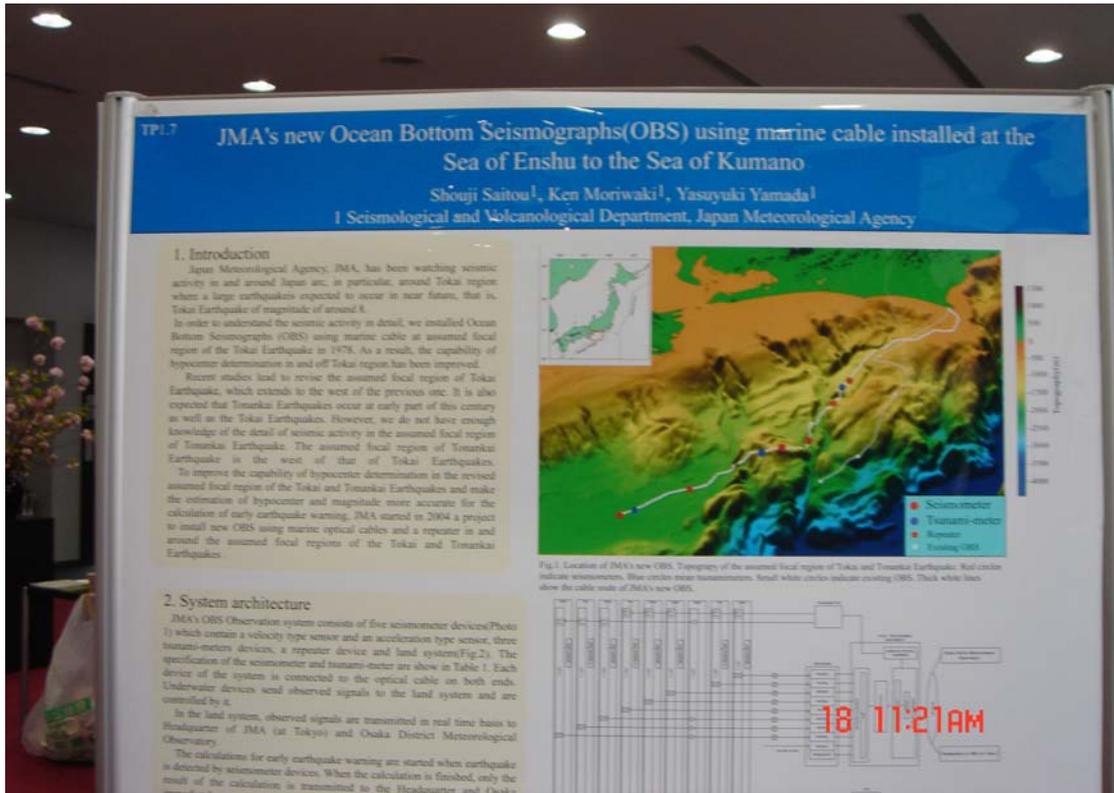


圖 2.5、大會海報展覽，圖中展示海報為日本氣象廳新建置海底電纜地震及海嘯觀測系統。



圖 2.6、本次會議與會人員之大合照。



圖 2.7、本次會議的大會議室。



圖 2.8、本次會議的個別小會議室。

### 三、心得

參與這次在日本東京舉行的國際會議時發現，世界上幾個先進國家或聯盟針對災害預防與科學研究之需要，紛紛投入大筆的經費，進行大型海底電纜式觀測系統的建置計畫，例如日本 JAMSTEC 的 DONET 計畫（圖 3.1）、日本氣象廳新海底電纜地震及海嘯觀測系統（圖 2.5）、美加合作 NEPTUNE 計畫（圖 3.2）以及歐盟 ESONET 計畫（圖 3.3）等；而我們台灣在此時推動媽祖計畫，不僅在實際防災需求上，對於未來東部海域地震與海嘯的防護，可以提供相當大的幫助，同時促使我國在海洋觀測技術與研究擠進先進國家之林，也會是一個很重要的契機。

經過粗略統計發現，本次會議與會發表的台灣學者眾多，口頭報告的人數占總數的 1/10 以上，主要為台大、中山與成功等大學的教授，例如雷射掃描於海床起伏測量之應用、水下聲波記錄器之改進與自動水下載具聲波記錄研發等等。此現象顯示台灣於水下工程技術方面的參與不乏人才，但受限於市場需求以及經費支援，往往難以深入研究或者自行研發相關器具（例如 AUV），不過日後若能網羅這些人才共同努力，相信對於媽祖計畫的執行以及國內水下技術的提升，將可形成雙贏之局面。

各國在正式建置海底電纜式觀測系統之前，都會針對該系統的建置設計成立任務小組，分別負責機電系統、資料傳輸、海底電纜與觀測節點等元件各自測試研發，並且相關的計畫名稱、標識（例如 NEPTUNE、DOENT、ESONET）與連絡辦公室也會事先完成。媽祖計畫應可以此為鏡，除前置作業（如路線調查與陸上站房建置等）應當儘速進行、妥善完成與全部結果公開之外，主要觀測設備與纜線的鋪設規劃更應謹慎評估考量、制定規格，寧可將計畫執行時間延至較為穩重確實可行的時程，以避免因倉促進行導致日後難以彌補的窘境。

目前世界各國已開發或開發中的海底電纜式觀測系統，主要分成嵌入式（Inline）與節點式（Node）兩大類。嵌入式系統的優點是技術純熟、價格便宜，缺點則是延伸性差（不能日後增裝設備）、備援性低（故障點之後的線路全部無法使用）；至於節點式系統的優點則是延展性佳（設備符合溼插拔規格即可透過 ROV 進行安裝）、備援性高（即使 1 個節點故障，其他節點仍能繼續運作），

缺點則是技術尚未純熟（美、加、日等國目前正在著手運作中）、價格昂貴（不論是一開始的纜線鋪設，或是利用 ROV 新增儀器，抑或日後維修）。未來台灣如何兼顧成本與目的，選擇所要建置的模式，有待專家學者提供更詳細的評估與建議。

海底電纜觀測系統建置所需的經費非常龐大，例如日本 DONET 約 6 千萬美金、加拿大金星計畫 (VENUS) 約 1 千萬美金、美國火星計畫 (MARS) 約 1,500 萬美金、美加海神計畫約 1 億美金等，折合新台幣從近 4 億元至 35 億元不等；而其經費的多寡主要受到嵌入或節點式系統之選用、海底電纜延伸長度、不同深度海底電纜種類之選擇、日後系統整體維護之考量以及安裝觀測設備的種類與數量等幾個因素所影響。媽祖計畫的進行，受到預算限制的程度相當大，當務之急，必須盡快確定可用經費額度，並藉此決定系統施做方式與時程，同時集合國內地震、地球物理與海洋科學 3 個領域的產、官、學界領域專家共同努力，才能有效達到預期目標。

藉由這次日本東京的造訪，除了在海纜觀測系統建置技術的瞭解上有豐碩成果外，另一方面從踏入機場、交通、飯店住宿一直到會議的參與，也深刻體會到日本政府與人民在公共衛生、社會安全、觀光發展等基礎項目的用心經營。舉例來說，在東京四通八達的地下捷運系統，不僅車內座位採用沙發座椅，而且並不禁止飲食，可是車廂內完全看不到一絲髒亂的景象，顯示公民教育與公共衛生維護相當落實，非常值得我們學習與借鏡。

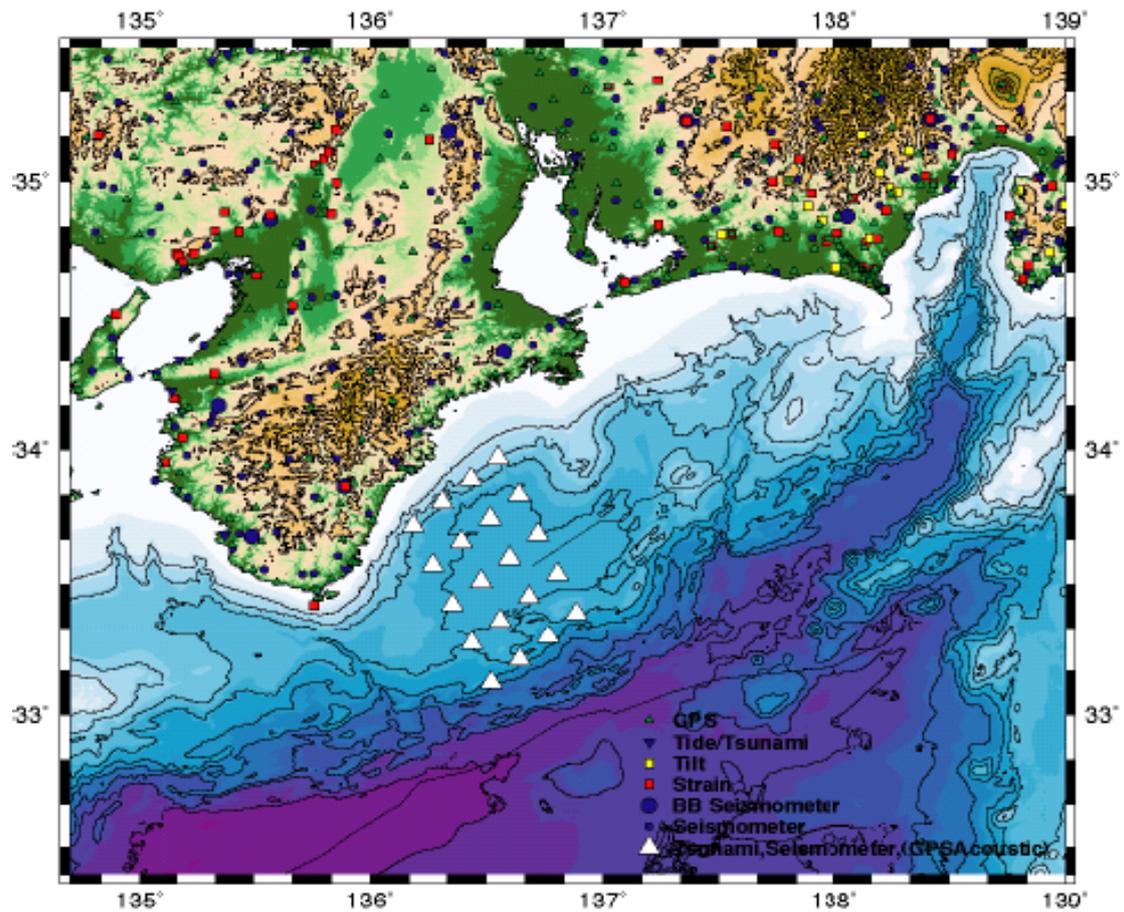


圖 3.1、日本 DONET 計畫建置構想圖，建置時程從 2006 年至 2009 年，預計在日本東南海裝置 20 個海底地震儀與壓力計，圖片摘自 Kawaguchi et al. (2007)。

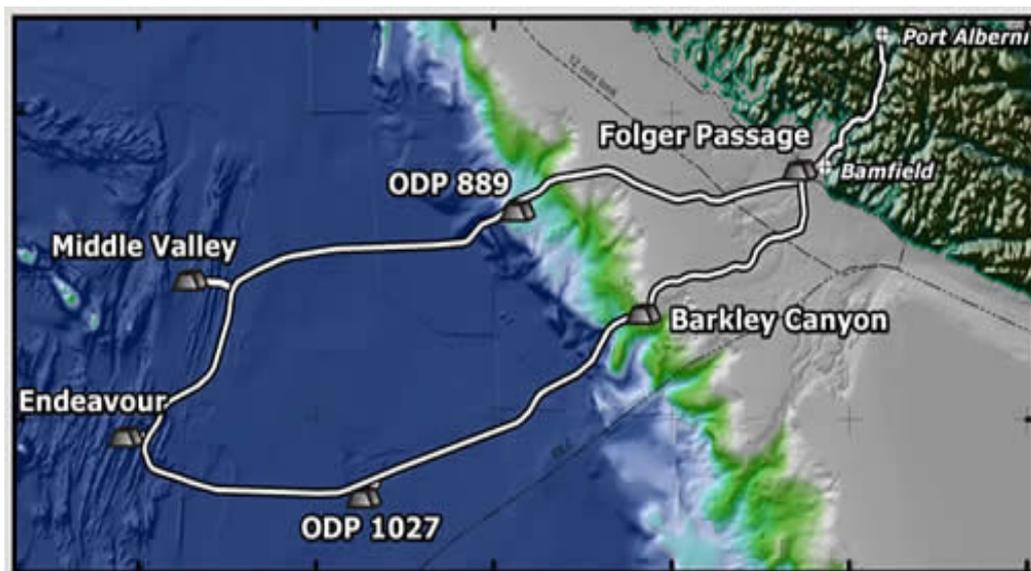


圖 3.2、美加合作 NEPTUNE 第一期計畫建置構想圖，建置時程從 2007 年至 2008 年，預計在加拿大哥倫比亞省外海建置 6 個觀測節點，圖片摘自 <http://www.neptunecanada.ca/>。

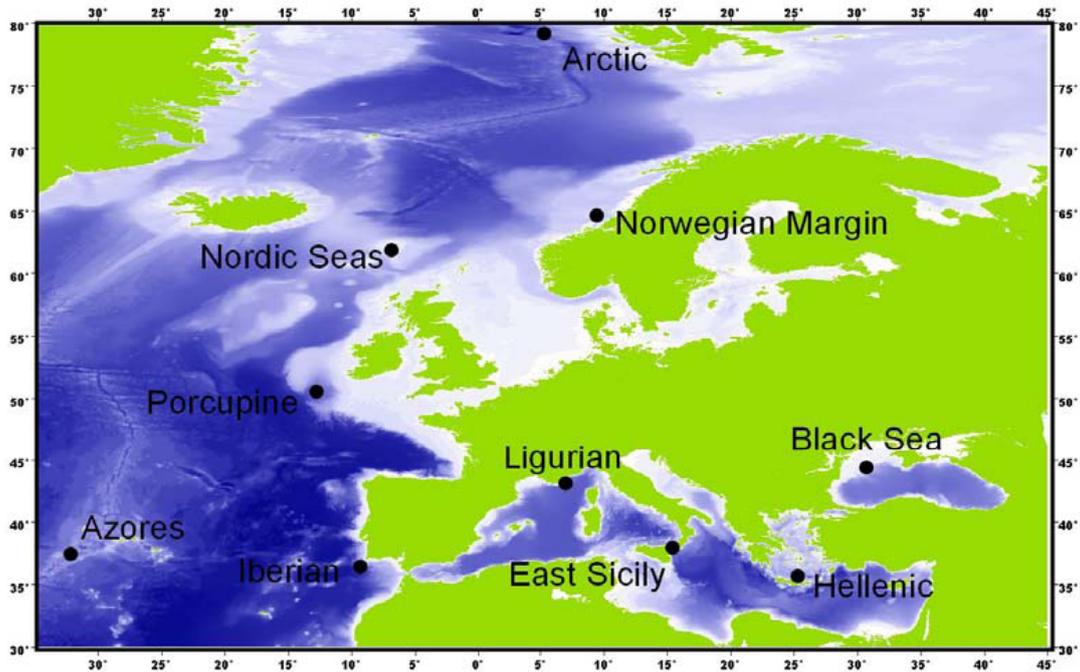


圖 3.3、歐盟 ESONET 計畫建置構想圖，此計畫為大型整合性計畫，規劃在歐洲 10 個地點設置電纜式觀測系統，每個系統之觀測目的根據實際需要各有不同，觀測資料提供各國分享使用，圖片摘自 [http://www.oceanlab.abdn.ac.uk/esonet/ESONET\\_fullrep.pdf](http://www.oceanlab.abdn.ac.uk/esonet/ESONET_fullrep.pdf)。

## 四、建議事項

職在參與完這次會議後，感覺受益良多，不僅對於系統的規劃與規格的研擬，有著更深一層的認知與經驗，同時對於媽祖計畫的執行，也比以往更具信心。以下即為彙整本人與本局地震測報中心其他參加同仁的想法後，針對媽祖計畫執行上的幾點建議：

1. 關於嵌入式或節點式觀測系統之選擇，嵌入式系統成熟、費用較低但擴充性小，節點式系統雖費用較高但具有較大擴充性，兩者各有優劣，宜多方評估。
2. 海底電纜觀測系統建置的經費相當龐大，其受到嵌入或節點式系統之選用、海底電纜延伸長度、不同深度海底電纜種類之選擇、日後系統整體維護之考量以及安裝觀測設備的種類與數量等因素所影響，而媽祖計畫必須盡快釐清可用經費之額度，方能有效確定系統施做之方式與時程。
3. 國際上進行海纜觀測系統建置的各國皆有優秀之學術界專家學者組成顧問團隊給予相關支援，建議媽祖計畫亦應成立國內學術界各相關領域專業人員所組成的科學顧問團，適時提供各項技術支援。
4. 各國已建置或建置中的觀測系統，皆準備有印製優美的宣導文件，並設置網站完整的介紹其系統，因此建議本中心可參考其方式，透過各種管道進行宣傳，例如文宣、網頁、辦理相關說明會等，使相關領域專業人員或社會大眾對計畫的執行能有更多的認識與瞭解。
5. 國際研討會是快速獲取最新技術資訊非常好的場所，因此建議本局除了可以繼續派員參與在各國舉行的相關會議外，也能夠適時在國內舉辦國際研討會，邀請國際上的專家至國內報告與交流，相信對於現階段媽祖計畫的執行，以及未來海洋觀測技術與研究的提升，將可提供非常具體的協助。

## 附録、研討議程

### Wednesday April 18

#### Opening Session

09:00-9:20

- Opening Remarks** Tamaki Ura, Symposium General Co-chair  
*Institute of Industrial Science, The University of Tokyo*
- Welcome** Masafumi Maeda  
*Director, Institute of Industrial Science, The University of Tokyo*
- Program Orientation** Shinichi Takagawa, Technical Committee Co-chair  
Japan Agency for Marine-Earth Science and Technology

#### Keynote

9:20-10:20

Session Chair:

Shinichi Takagawa, Japan Agency for Marine-Earth Science and Technology

- Keynote 1** Neptune: Transforming Ocean and Earth Sciences with Distributed Submarine Sensor Networks Wired to Next Generation Internet  
J. R. Delaney and J. M. Paros  
*University of Washington, USA*
- Keynote 2** Dive of AUV "r2D4" to "The Great Dodo Lava Plain" in the Rift Valley of the Central Indian Mid-Ocean Ridge System  
T. Ura  
*The University of Tokyo, JAPAN*

#### Workshop Photo

10:20-10:50

#### Session WA1: Present Vehicles/Achievements

10:50-12:10

Session Chairs:

Katsuyoshi Kawaguchi, Japan Agency for Marine-Earth Science and Technology

William J. Kirkwood, Monterey Bay Aquarium Research Institute

- WA1.1** Development of Deep Sea ROV "KAIKO7000II"  
H. Nakajoh<sup>1</sup>, T. Murashima<sup>1</sup>, N. Yamauchi<sup>2</sup> and H. Sezoko<sup>2</sup>  
<sup>1</sup>Japan Agency for Marine-Earth Science and Technology (JAMSTEC), JAPAN and <sup>2</sup>Nippon Marine Enterprises, Ltd., JAPAN
- WA1.2** Comparison of MBARI Autonomous Underwater Mapping Results for ORION Monterey Accelerated Research System (MARS) and Neptune Canada  
W. J. Kirkwood and D. W. Caress  
*Monterey Bay Aquarium Research Institute, USA*
- WA1.3** 1000 Dives by the Shinkai 6500 in 18 Years  
T. Komuku, K. Matsumoto, Y. Imai, T. Sakurai and K. Ito  
*Nippon Marine Enterprises, Ltd.(NME), JAPAN*
- WA1.4** A Deepest Depth ROV for Sediment Sampling and Its Sea Trial Result  
H. Yoshida, T. Aoki, H. Osawa, S. Ishibashi, Y. Watanabe, J. Tahara, T. Miyazaki and K. Itoh  
*Japan Agency for Marine-Earth Science and Technology, JAPAN*

**Session WB1: Acoustic Network**

**10:50-12:10**

Session Chairs:

Winston K.G. Seah, *Network Technology Department, Institute for Infocomm Research*

Bruce M. Howe, *Applied Physics Laboratory, University of Washington*

- WB1.1** Efficient Data Delivery with Packet Cloning for Underwater Sensor Networks  
P. Sun<sup>1</sup>, W. K. G. Seah<sup>1,2</sup> and P. W. Q. Lee<sup>2</sup>  
<sup>1</sup>*Institute for Infocomm Research, SINGAPORE* and <sup>2</sup>*National University of Singapore, SINGAPORE*
- WB1.2** High Speed Acoustic Network with 2MHz Carrier Frequency for Seafloor Geodetic Observation Robot System  
H. Jun<sup>1,2</sup>, A. Asada<sup>2</sup> and Y. Yagita<sup>3</sup>  
<sup>1</sup>*Shanghai Fisheries University, CHINA*, <sup>2</sup>*University of Tokyo, JAPAN* and <sup>3</sup>*Honda Electronics Co., Ltd., JAPAN*
- WB1.3** Sensor Network Infrastructure: Moorings, Mobile Platforms, and Integrated Acoustics  
B. M. Howe, T. McGinnis and M. L. Boyd  
*University of Washington, USA*

**Session WA2: Seafloor Engineering**

**13:00-1500**

Session Chairs:

Tetsuya Shiraishi, *Port and Airport Research Institute*

Nicholas P. Chotiros, *Applied Research Laboratories, University of Texas at Austin*

- WA2.1** Seafloor Roughness Measurement from a ROV  
N. P. Chotiros<sup>1</sup>, M. J. Isakson<sup>1</sup>, J. N. Piper<sup>1</sup> and M. Zampolli<sup>2</sup>  
<sup>1</sup>*The University of Texas at Austin, USA* and <sup>2</sup>*NATO Undersea Research Centre, ITALY*
- WA2.2** Development of Simple Holding Device with Net Chain Applying to Wave-Dissipating Blocks, Floats and Sinking Objects of Various Shapes  
H. Noguchi  
*Port and Airport Research Institute, JAPAN*
- WA2.3** Underwater Soil Improvement for Port Facilities by Compaction Piles of Oyster Shell-Sand Mixture  
K. Mikami<sup>1</sup> and T. Okumura<sup>2</sup>  
<sup>1</sup>*Ministry of Land, Infrastructure and Transport, JAPAN* and <sup>2</sup>*DRAM Engineering Inc., JAPAN*
- WA2.4** Measurement of Seabed Roughness with Laser Scanning System  
C.-C. Wang<sup>1</sup>, P.-C. Chen<sup>1</sup>, M.-W. Hung<sup>1</sup>, C.-R. Chu<sup>1</sup>, D. J. Tang<sup>2</sup> and T. Hefner<sup>2</sup>  
<sup>1</sup>*National Sun Yat-sen University, TAIWAN* and <sup>2</sup>*University of Washington, USA*
- WA2.5** Parametric Study on Random Internal Waves in a Two-Fluid System  
C.-M. Liu  
*Chienkuo Technology University, TAIWAN*
- WA2.6** Application of Integrated Numerical Research System for Prevention and Estimation of Coastal Disaster for the Case of Shikoku Island, Japan  
I. Noda<sup>1</sup>, T. Kondou<sup>1</sup>, T. Takagi<sup>1</sup>, Y. Koyano<sup>2</sup>, M. Ando<sup>2</sup>, H. Shibaki<sup>3</sup> and N. Hara<sup>3</sup>  
<sup>1</sup>*Shikoku Regional Development Bureau, JAPAN*, <sup>2</sup>*Coastal Development Institute of Technology, JAPAN* and  
<sup>3</sup>*ECOH Corporation, JAPAN*

**Session WB2: Recording and Recognition of Sound**

13:00-1500

Session Chairs:

Sean Wiggins, *Scripps Institution of Oceanography*

Jun Han, *University of Tokyo*

- WB2.1** Applying Point-Based Principal Component Analysis on Environment, Ships and Cetaceans Whistles Signal Classification  
C.-M. Wang<sup>1</sup>, C.-C. Wang<sup>1</sup>, S.-W. Hu<sup>1</sup>, S.-L. Luo<sup>1</sup> and B. B. Ma<sup>2</sup>  
<sup>1</sup>National Sun Yat-sen University, TAIWAN and <sup>2</sup>Naval Academy Department of Marine Science, TAIWAN
- WB2.2** Development of MSP430-Based Underwater Acoustic Recorder with Multi-MCU Framework  
Y.-H. Hsiao<sup>1</sup>, M.-C. Huang<sup>1</sup> and C.-C. Wang<sup>2</sup>  
<sup>1</sup>National Cheng Kung University, TAIWAN and <sup>2</sup>National Sun Yet-sen University, TAIWAN
- WB2.3** Design and Application of Autonomous Underwater Acoustic Recorder  
M.-H. Chiu, C.-C. Wang, J.-Y. Liu and C.-W. Chang  
National Sun Yat-sen University, TAIWAN
- WB2.4** Analysis of Short Term Temporal Fluctuations in Noise Power Spectrum of Shallow Water Ambient Noise (This presentation has been cancelled)  
S. Ramji<sup>1</sup>, S. Ramakrishanan<sup>1</sup> and G. Latha<sup>2</sup>  
<sup>1</sup>Anna University, INDIA and <sup>2</sup>National Institute of Ocean Technology, INDIA
- WB2.5** The Simulation of the ROV Motion with Anti-Pitch Control in Uniform Current  
M.-C. Fang and Y.-L. Huang  
National Cheng Kung University, TAIWAN

**Session WA3: Sonar Technology and Bathymetric Survey**

15:20-17:40

Session Chairs:

Akira Asada, *University of Tokyo*

Soncheol Yu, *Department of Mechanical Eng., University of Hawaii*

- WA3.1** Automatic Detection and Classification of Man-Made Targets in Side Scan Sonar Images  
A. L. Chew, P. B. Tong and C. S. Chia  
DSO National Laboratories, SINGAPORE
- WA3.2** Development of Diver Detection and Sensor Integration for Wharf Surveillance Software  
F. Maeda<sup>1</sup>, A. Asada<sup>1</sup>, K. Kuramoto<sup>2</sup>, Y. Kurashige<sup>2</sup>, M. Nanri<sup>3</sup>, Y. Kawashima<sup>3</sup>, R. Imai<sup>3</sup> and K. Hantani<sup>4</sup>  
<sup>1</sup>University of Tokyo, JAPAN, <sup>2</sup>Japan Coast Guard Academy, JAPAN, <sup>3</sup>Hitachi Limited, JAPAN and <sup>4</sup>Toyo Corporation, JAPAN
- WA3.3** Real-Time 3D Sonar Image Recognition for Underwater Vehicles  
S.-C. Yu, T.-W. Kim, G. Marani and S. K. Choi  
University of Hawaii, USA
- WA3.4** Evolution and Future of Multibeam Echosounder Technology  
B. Volberg and T. Meurling  
The RESON Group, USA
- WA3.5** Bathymetric Survey at Hydrothermal Site by L-Array Interferometric Sonar Mounted on AUV-r2D4  
H. Koyama<sup>1</sup>, A. Asada<sup>1</sup>, T. Ura<sup>1</sup>, H. Jun<sup>1</sup>, T. Obara<sup>2</sup> and K. Nagahasi<sup>2</sup>  
<sup>1</sup>University of Tokyo, JAPAN and <sup>2</sup>Mitsui Engineering & Shipbuilding Co., Ltd., JAPAN
- WA3.6** Maximum Likelihood Approach to Bottom Detection in Deep Water Multibeam Echo Sounders  
G. Yufit, E. Maillard and L. D. Pedersen  
RESON Inc., USA

- WA3.7** Observation of Seafloor Crustal Deformation at the Nankai Margin, Japan  
 K. Tadokoro<sup>1</sup>, M. Ando<sup>1</sup>, T. Okuda<sup>1</sup>, S. Sugimoto<sup>1</sup>, T. Watanabe<sup>1</sup>, Y. Aizawa<sup>1</sup>, J. Yasuda<sup>1</sup>  
 and M. Kuno<sup>2</sup>  
<sup>1</sup>Nagoya University, JAPAN and <sup>2</sup>Mie Prefectural Science and Technology Promotion  
 Center, JAPAN  
 (This paper is assigned a number TA1.4 in CD-R)

**Session WB3: Technology for Network System**  
 15:20-17:40

Session Chairs:  
 Peter G Phibbs, *NEPTUNE project, University of Victoria*  
 Kenichi Asakawa, *JAMSTEC*

- WB3.1** Deep Sea Net: an Affordable, and Expandable Solution for Deep Sea Sensor Networks  
 P. Valdy<sup>1</sup>, V. Ciausiu<sup>1</sup>, P. Léon<sup>1</sup>, P. Moriconi<sup>1</sup>, V. Rigaud<sup>1</sup>, Y. Hello<sup>2</sup>, P. Charvis<sup>2</sup>, A.  
 Deschamps<sup>2</sup> and C. Sillans<sup>3</sup>  
<sup>1</sup>Ifremer, FRANCE, <sup>2</sup>Géosciences Azur, FRANCE and <sup>3</sup>IFOTEC, FRANCE
- WB3.2** A Design Concept of Seafloor Observatory Network for Earthquakes and Tsunamis  
 K. Kawaguchi, E. Araki and Y. Kaneda  
*Japan Agency for Marine-Earth Science and Technology, JAPAN*
- WB3.3** NEPTUNE Stage I Network Architecture  
 P. Phibbs<sup>1</sup> and S. Lentz<sup>2</sup>  
<sup>1</sup>NEPTUNE Canada, University of Victoria, CANADA and <sup>2</sup>Lentz Telecommunications  
 Strategies LLC, USA
- WB3.4** Outline of New Cabled Observation System off Toyohashi  
 K. Asakawa, T. Yokobiki, T. Goto, E. Araki, M. Kinoshita and K. Mitsuzawa  
*JAMSTEC, JAPAN*
- WB3.5** Power and Communication Architectures for Cabled Subsea Observatories  
 S. Barlow<sup>1</sup>, J. Flynn<sup>1</sup>, S. Terada<sup>2</sup> and W. Mudge<sup>1</sup>  
<sup>1</sup>Ocean Design Inc., USA and <sup>2</sup>Shoshin, JAPAN
- WB3.6** Open Architecture Submarine Cable Observatory Systems  
 N. J. Hazell, G. Waterworth and A. Lecroart  
*Alcatel Submarine Networks, UK*

**Thursday, April 19**

**Keynote**

Session Chair:  
 Robert Wernli  
*First Centurion Enterprises*

- Keynote 3** Hybrid ROV for 11,000 Meter Operations  
 A. D. Bowen<sup>1</sup>, D. Yoerger<sup>1</sup> and L. Whitcomb<sup>2</sup>  
<sup>1</sup>Woods Hole Oceanographic Institution, USA and <sup>2</sup>Johns Hopkins University, USA
- Keynote 4** Underwater Cable Network: Capturing Processes in the Ocean  
 K. Suyehiro  
*JAMSTEC, JAPAN*
- Keynote 5** Microfluidics-Based in situ Biological and Chemical Sensing  
 - Towards Integrated and Real-Time Measurement in Deep Sea -  
 T. Fujii and T. Fukuba  
*University of Tokyo, JAPAN*

**Session TA1: GPS/A and Precise Positioning**

**10:50-12:10**

Session Chair:

Hiromi Fujimoto, *Graduate School of Science, Tohoku University*

Lionel Faure, *iXsea*

- TA1.1**      **Toward Semi-real-time GPS/A Seafloor Positioning with a Moored Buoy**  
H. Fujimoto<sup>1</sup>, M. Kido<sup>1</sup>, Y. Osada<sup>1</sup> and Y. Kaneda<sup>2</sup>  
<sup>1</sup>*Tohoku University, JAPAN* and <sup>2</sup>*JAMSTEC, JAPAN*
- TA1.2**      **Development of Precision Underwater Positioning System**  
H. Yoshida<sup>1</sup> and T. Mori<sup>2</sup>  
<sup>1</sup>*Ministry of Land, Infrastructure and Transport, JAPAN* and <sup>2</sup>*Oki Electric Co., Ltd., JAPAN*
- TA1.3**      **Development of Seafloor Geodetic Observation System Based on AUV Technology**  
M. Mochizuki<sup>1</sup>, A. Asada<sup>1</sup>, T. Ura<sup>1</sup>, T. Tanaka<sup>2</sup>, H. Zheng<sup>2</sup>, T. Ensign<sup>3</sup>, K. Kawai<sup>4</sup>, O. L. Colombo<sup>5</sup> and K. Nagahashi<sup>6</sup>  
<sup>1</sup>*University of Tokyo, JAPAN*, <sup>2</sup>*SEA Corporation, JAPAN*, <sup>3</sup>*Engineering Acoustics, Inc., USA*,  
<sup>4</sup>*Japan Coast Guard, JAPAN*, <sup>5</sup>*G.E.S.T./NASA Goddard Space Flight Center, USA* and  
<sup>6</sup>*Mitsui Engineering and Shipbuilding Co., Ltd., JAPAN*
- TA1.4**      **Use of Rangemeter in Advanced and Modular Subsea Positioning Solutions**  
F. Crétollier and P.-Y. Morvan  
*iXSea SAS, FRANCE*  
(This paper is assigned a number **WA3.7** in CD-R)

**Session TB1: Sensors**

**10:50-12:10**

Session Chairs:

Teruo Fujii, *University of Tokyo*

Darius Modarress, *MSE (Measurement Science Enterprise, Inc.)*

- TB1.1**      **Micro-Optical Sensors for Underwater Velocity Measurement**  
D. Modarress<sup>1</sup>, P. Svitek<sup>1</sup>, K. Modarress<sup>1</sup> and D. W. Wilson<sup>2</sup>  
<sup>1</sup>*MSE (Measurement Science Enterprise Inc.), USA* and <sup>2</sup>*JPL (Jet Propulsion Laboratory), USA*
- TB1.2**      **Development of an Integrated *In Situ* Analyzer for Quantitative Analysis of Microbial ATP in Aquatic Environments**  
T. Fukuba<sup>1</sup>, N. Fukuzawa<sup>1</sup>, L. S. Glutz<sup>2</sup>, A. Miyaji<sup>3</sup> and T. Fujii<sup>1</sup>  
<sup>1</sup>*The University of Tokyo, JAPAN*, <sup>2</sup>*Ecole Polytechnique Federale de Lausanne (EPFL), SWITZERLAND* and <sup>3</sup>*Tokyo Institute of Technology, JAPAN*
- TB1.3**      **Laser-Interferometric Broadband Seismometer for Ocean Borehole Observations**  
A. Araya<sup>1</sup>, K. Sekiya<sup>2</sup> and Y. Shindo<sup>2</sup>  
<sup>1</sup>*University of Tokyo, JAPAN* and <sup>2</sup>*Oki Electric Industry Co., Ltd., JAPAN*
- TB1.4**      **Acoustical Surveys of Methane Plumes using the Quantitative Echo Sounder in Japan Sea**  
C. Aoyama<sup>1</sup>, R. Matsumoto<sup>2</sup>, A. Hiruta<sup>2</sup>, O. Ishizaki<sup>2</sup>, H. Machiyama<sup>3</sup>, H. Numanami<sup>4</sup>, M. Hiromatsu<sup>5</sup> and G. Snyder<sup>6</sup>  
<sup>1</sup>*Japan's Independent Institute Co., Ltd., JAPAN*, <sup>2</sup>*University of Tokyo, JAPAN*, <sup>3</sup>*Japan Agency for Marine Earth Science and Technology, JAPAN*, <sup>4</sup>*Tokyo Kasei-Gakuin, JAPAN*,  
<sup>5</sup>*Chiba University, JAPAN* and <sup>6</sup>*Rice University, USA*

Session TP1: Poster Session

13:00-13:50

- TP1.1 Re-Evaluation of Linear Trend of Submarine Cable Voltages for the Study of the Toroidal Field Variation at the CMB  
H. Shimizu and H. Utada  
*University of Tokyo, JAPAN*
- TP1.2 The Effects of Local Structure on Seafloor Ambient Noise at the Hawaii-2 Observatory  
R. A. Stephen<sup>1</sup>, P. D. Bromirski<sup>2</sup> and F. K. Duennebie<sup>3</sup>  
<sup>1</sup>*Woods Hole Oceanographic Institution, USA*, <sup>2</sup>*Scripps Institution of Oceanography, USA*  
and <sup>3</sup>*University of Hawaii, USA*
- TP1.3 Application of Cabled Offshore Ocean Bottom Tsunami Gauge Data for Real-Time Tsunami Forecasting  
H. Tsushima<sup>1</sup>, R. Hino<sup>1</sup>, H. Fujimoto<sup>1</sup> and Y. Tanioka<sup>2</sup>  
<sup>1</sup>*Tohoku University, JAPAN* and <sup>2</sup>*Hokkaido University, JAPAN*
- TP1.4 Sea Floor Mapping using the Data of Forward Looking Sonar and Side-Scan Sonar around the Hydrothermal Sites, South Mariana Trough  
M. Joshima, K. Kisimoto and K. Nishimura  
*National Institute of Advanced Industrial Science and Technology, JAPAN*
- TP1.5 In Situ Ocean Acidification Environmental Observations: MBARI's Cabled Observatory Technology for Controlled Studies of Changing Ocean pH  
W. J. Kirkwood, E. T. Peltzer and P. G. Brewer  
*Monterey Bay Aquarium Research Institute, USA*
- TP1.6 Detecting, Tracking and Classifying Animals in Underwater Observatory Video  
D. R. Edgington, D. E. Cline, J. Mariette and I. Kerkez  
*Monterey Bay Aquarium Research Institute, USA*
- TP1.7 JMA's New Ocean Bottom Seismographs (OBS) using Marine Cable Installed at the Sea of Enshu to the Sea of Kumano  
S. Saito, K. Moriwaki and Y. Yamada  
*Japan Meteorological Agency, JAPAN*
- TP1.8 Adaptive SONAR Sounds by Echolocating Bats  
T. Hagino, S. Hiryu, S. Fujioka, H. Riquimaroux and Y. Watanabe  
*Doshisha University, JAPAN*
- TP1.9 Direct Observation of Deep-sea Animals using a Deep Seafloor Observatory at the Depth of 3,572 m in Nankai Trough, Japan  
N. Iwasaki<sup>1</sup> and H. Momma<sup>2</sup>  
<sup>1</sup>*Kochi University, JAPAN* and <sup>2</sup>*The Japan Marine Science and Technology Center, JAPAN*
- TP1.10 Development of Integrated *In Situ* Analyzer for Manganese (IISA-Mn) in Deep Sea Environment  
C. Provin, T. Fukuba and T. Fujii  
*University of Tokyo, JAPAN*
- TP1.11 Long-Term Seafloor and Land-Based Seismological Monitoring at Southwestern End of the Kurile Subduction Zone, Based on More Than Six-Year Continuous Observation  
T. Watanabe<sup>1</sup>, H. Mikada<sup>2</sup> and M. Kasahara<sup>3</sup>  
<sup>1</sup>*Japan Agency of Marine Earth-Science and Technology, JAPAN*, <sup>2</sup>*Kyoto University, JAPAN* and <sup>3</sup>*Hokkaido University, JAPAN*
- TP1.12 Scientific Survey and Monitoring of the Off-Shore Seismogenic Zone with Tokai SCANNER: Submarine Cabled Network Observatory for Nowcast of Earthquake Recurrence in the Tokai Region, Japan  
T. Goto<sup>1</sup>, T. Kasaya<sup>1</sup>, M. Kinoshita<sup>1</sup>, E. Araki<sup>1</sup>, K. Kawaguchi<sup>1</sup>, K. Asakawa<sup>1</sup>, T. Yokobiki<sup>1</sup>, M. Harada<sup>2</sup>, T. Nakajima<sup>3</sup>, H. Nagao<sup>1</sup> and K. Sayanagi<sup>4</sup>  
<sup>1</sup>*Japan Agency for Marine-Earth Science and Technology, JAPAN*, <sup>2</sup>*Chiba University, JAPAN* and <sup>3</sup>*Tokai University, JAPAN*

- TP1.13 Multidisciplinary Observations at an Expandable Sub-Marine Cabled Station off the Hatsushima Island, the Sagami Bay, Japan  
T. Kasaya<sup>1</sup>, K. Mitsuzawa<sup>1</sup>, T. Goto<sup>1</sup>, K. Sayanagi<sup>2</sup>, E. Araki<sup>1</sup>, K. Asakawa<sup>1</sup>, R. Iwase<sup>1</sup>, H. Mikada<sup>3</sup> and T. Nagao<sup>2</sup>  
<sup>1</sup>Japan Agency for Marine-Earth Science and Technology, JAPAN, <sup>2</sup>Tokai University, JAPAN and <sup>3</sup>Kyoto University, JAPAN
- TP1.14 Evaluation Method of Remaining Oil Properties in a Sunken Ship Using Ultrasonic Technique  
M. Shimada and K. Hoshino  
National Maritime Research Institute, JAPAN
- TP1.15 Seafloor Borehole Broadband Seismic Observatories in the Western Pacific and Performance of Recovered Seismic Data  
M. Shinohara<sup>1</sup>, E. Araki<sup>2</sup>, T. Kanazawa<sup>1</sup>, K. Suyehiro<sup>2</sup>, M. Mochizuki<sup>1</sup>, T. Yamada<sup>1</sup>, K. Mochizuki<sup>1</sup>, K. Nakahigashi<sup>1</sup> and Y. Kaiho<sup>2</sup>  
<sup>1</sup>University of Tokyo, JAPAN and <sup>2</sup>Japan Agency for Marine-Earth Science and Technology, JAPAN
- TP1.16 A Deepwater Tsunami Surveillance System for Malaysia  
S. E. Aasen<sup>1</sup>, Z. Mustapha<sup>2</sup>, P. Schjølberg<sup>1</sup> and T. Elliott<sup>3</sup>  
<sup>1</sup>Fugro OCEANOR, NORWAY, <sup>2</sup>Astronautic Technology (M) SDN BHD, MALAYSIA and <sup>3</sup>Fugro GEOS, SINGAPORE

**Session TA2: New Vehicles/Subsystems-1**

**14:00-15:40**

Session Chairs:

Manoj T. Issac, *Ocean & Naval Architecture Engineering, Memorial University of Newfoundland*

Pan-Mook Lee, *MOERI-KORDI (Maritime & Ocean Engineering Research Institute)*

- TA2.1 Maneuvering Experiments Using the *MUN Explorer* AUV  
M. T. Issac<sup>1</sup>, S. Adams<sup>1</sup>, M. He<sup>1</sup>, N. Bose<sup>1</sup>, C. D. Williams<sup>2</sup>, R. Bachmayer<sup>2</sup> and T. Crees<sup>3</sup>  
<sup>1</sup>Memorial University of Newfoundland (MUN), CANADA, <sup>2</sup>National Research Council, Institute for Ocean Technology, CANADA and <sup>3</sup>International Submarine Engineering, CANADA
- TA2.2 A Detection Algorithm of a Test-Bed AUV, SNUUV-II  
D. C. Seo, G. N. Jo and H. S. Choi  
Seoul National University, KOREA
- TA2.3 Shoreline Survey Method using Amphibious Walking Robot and the Navigation Method Regarding Amphibious Traveling  
T. Tanaka, T. Shiraishi and T. Hirabayashi  
Port and Airport Research Institute, JAPAN
- TA2.4 Sea-Trial and Experimental Results of the Deep-Sea Unmanned Underwater Vehicles, HEMIRE and HENUVY  
P. Lee<sup>1</sup>, B. Jun<sup>1</sup>, K. Kim<sup>1</sup>, H. Choi<sup>1</sup>, J. Li<sup>1</sup>, C. Lee<sup>1</sup>, S. Ryu<sup>1</sup>, H. Baek<sup>1</sup>, S. Hong<sup>1</sup>, Y. Lim<sup>1</sup>, D. Kim<sup>2</sup>, S. Cho<sup>2</sup>,  
D. Park<sup>2</sup>, B. Gu<sup>3</sup>, J. Lee<sup>3</sup>, H. Jung<sup>3</sup>, S. Yoon<sup>3</sup>, C. Park<sup>3</sup>, M. Choi<sup>3</sup> and Y. Seo<sup>3</sup>  
<sup>1</sup>MOERI, KORDI, KOREA, <sup>2</sup>SSI, KORDI, KOREA and <sup>3</sup>Daeyang Electric Co., Ltd., KOREA
- TA2.5 Development and Experiment of a Hovering AUV Tested-Bed for Underwater Exploration  
S.-W. Byun<sup>1</sup>, J.-Y. Kim<sup>1</sup>, S.-K. Lee<sup>2</sup>, J.-C. Park<sup>2</sup> and K.-S. Kim<sup>2</sup>  
<sup>1</sup>Cheju National University, KOREA and <sup>2</sup>Pusan National University, KOREA

**Session TB2: New Project of Network System**

**14:00-15:40**

Session Chairs:

Roland Person, *Ifremer*

Christopher R. Barnes, *NEPTUNE Canada, University of Victoria*

- TB2.1 Long Term Multidisciplinary Deep Sea Observatories: How to Find Compromise between Scientific Needs, Technological Capabilities and Financial Resources; The ESONET Contribution  
R. Person  
*Ifremer, FRANCE*
- TB2.2 Precise Real-Time Observatory and Simulating Phenomena of Earthquakes and Tsunamis Around the Nankai Trough - Towards the Understanding of Mega Thrust Earthquakes -  
Y. Kaneda, K. Kawaguchi, E. Araki, H. Matsumoto, T. Nakamura, S. Kamiya, T. Hori and T. Baba  
*Japan Agency for Marine-Earth Science and Technology, JAPAN*
- TB2.3 Cable-Based Geophysical Measurement and Monitoring Systems, New Possibilities for Tsunami Early-Warnings  
T. Schmitz<sup>1</sup>, W. Rutzen<sup>1</sup> and W. Jokat<sup>2</sup>  
<sup>1</sup>*Norddeutsche Seekabelwerke GmbH & Co KG (NSW), GERMANY* and  
<sup>2</sup>*Alfred-Wegener-Institute for Polar and Marine Research, GERMANY*
- TB2.4 Marine Cable Hosted Observatory (MACHO) Project in Taiwan  
S.-K. Hsu<sup>1</sup>, C.-S. Lee<sup>2</sup>, T.-C. Shin<sup>3</sup>, C.-S. Liu<sup>4</sup>, B.-S. Huang<sup>5</sup>, B.-Y. Kuo<sup>5</sup>, C.-H. Lin<sup>5</sup>, D. Tang<sup>4</sup>, H.-Y. Chang<sup>4</sup> and C.-H. J. Kuo<sup>6</sup>  
<sup>1</sup>*National Central University, TAIWAN*, <sup>2</sup>*National Taiwan Ocean University, TAIWAN*,  
<sup>3</sup>*Central Weather Bureau, TAIWAN*, <sup>4</sup>*National Taiwan University, TAIWAN*, <sup>5</sup>*Institute of Earth Science, Academia Sinica, TAIWAN* and <sup>6</sup>*Chung-Hwa Telecom, TAIWAN*
- TB2.5 The NEPTUNE Project - a Cabled Ocean Observatory in the NE Pacific: Overview, Challenges and Scientific Objectives for the Installation and Operation of Stage I in Canadian Waters  
C. R. Barnes, M. M. R. Best, B. D. Bornhold, S. K. Juniper, B. Pirenne and P. Phibbs  
*University of Victoria, CANADA*

**Session TA3: New Vehicles/Subsystems-2**

**16:00-17:40**

Session Chairs:

Shinichi Takagawa, *Marine Technology Center, JAMSTEC*

Oscar Calvo, *University of the Balearic Islands*

- TA3.1 AquaBox Series: Small Underwater Robot Systems for Shallow Water Observation  
S. Ohata, Y. Eriguchi and K. Ishii  
*Kyushu Institute of Technology, JAPAN*
- TA3.2 Development of Glider Type Small AUV "SeaBird"  
S. Araki and K. Ishii  
*Kyushu Institute of Technology, JAPAN*
- TA3.3 Feasibility Study on DMFC Power Source for Underwater Vehicles  
S. Takagawa  
*Japan Agency for Marine-Earth Science and Technology, JAPAN*
- TA3.4 Low-cost Autonomous Underwater Vehicle for Pipeline and Cable Inspections  
G. G. Acosta<sup>1</sup>, O. A. Calvo Ibáñez<sup>2</sup>, H. J. Curti<sup>1</sup> and A. F. Rozenfeld<sup>2</sup>  
<sup>1</sup>*Universidad Nac. del Centro Prov. de Buenos Aires, ARGENTINA* and <sup>2</sup>*Universitat de les Illes Balears, SPAIN*

- TA3.5 Development and Control of an Underwater Manipulator for AUV  
M. Ishitsuka and K. Ishii  
*Kyushu Institute of Technology, JAPAN*

**Session TB3: Submarine Cable Application - 1**  
**16:00-17:40**

Session Chairs:

Giuditta Marinaro, *Istituto Nazionale di Geofisica e Vulcanologia*  
Toshitaka Gamo, *Ocean Research Institute, the University of Tokyo*

- TB3.1 A Cabled Monitoring Module for Gas Seepage: The First Experiment in a Pockmark (Patras Gulf, Greece)  
G. Marinaro<sup>1</sup>, G. Etiope<sup>1</sup>, N. Lo Bue<sup>1</sup>, P. Favali<sup>1</sup>, G. Papatheodorou<sup>2</sup>, D. Christodoulou<sup>2</sup>, F. Furlan<sup>3</sup>, F. Gasparoni<sup>3</sup>, G. Ferentinos<sup>2</sup>, M. Masson<sup>4</sup> and J.-F. Rolin<sup>5</sup>  
<sup>1</sup>*Istituto Nazionale di Geofisica e Vulcanologia (INGV), ITALY*, <sup>2</sup>*University of Patras, GREECE*,  
<sup>3</sup>*TECNOMARE-ENI SpA, ITALY*, <sup>4</sup>*FRANATECH GmbH, GERMANY* and <sup>5</sup>*IFREMER, FRANCE*
- TB3.2 Development of Seafloor Seismic and Tsunami Observation System  
K. Fujihashi<sup>1</sup>, T. Aoki<sup>1</sup>, M. Okutsu<sup>1</sup>, K. Arai<sup>2</sup>, T. Komori<sup>3</sup>, H. Fujita<sup>3</sup>, Y. Kurosawa<sup>4</sup>, Y. Fujinawa<sup>5</sup> and K. Sasaki<sup>5</sup>  
<sup>1</sup>*NTT InfraNet Corporation, JAPAN*, <sup>2</sup>*Tokyo Sokushin Co., Ltd., JAPAN*, <sup>3</sup>*NTT World Engineering Marine Corporation, JAPAN*, <sup>4</sup>*Hitachi Cable, Ltd., JAPAN* and <sup>5</sup>*Real-time Earthquake Information Consortium, JAPAN*
- TB3.3 *In Situ* Measurement of Dissolvable Mn in Bottom Seawater in Combination with a Deep-Sea Cable off  
Hatsushima Island, Western Sagami Bay, Japan  
T. Gamo<sup>1</sup>, K. Okamura<sup>2</sup>, K. Mitsuzawa<sup>3</sup> and K. Asakawa<sup>3</sup>  
<sup>1</sup>*The University of Tokyo, JAPAN*, <sup>2</sup>*Kochi University, JAPAN* and <sup>3</sup>*Japan Agency for Marine-Earth Science and Technology (JAMSTEC), JAPAN*
- TB3.4 A New Low Cost Ocean Bottom Cabled Seismometers  
T. Kanazawa<sup>1</sup>, M. Shinohara<sup>1</sup>, S. Sakai<sup>1</sup>, O. Sano<sup>1</sup>, H. Utada<sup>1</sup>, H. Shiobara<sup>1</sup>, Y. Morita<sup>1</sup>, T. Yamada<sup>1</sup> and K. Yamazaki<sup>2</sup>  
<sup>1</sup>*The University of Tokyo, JAPAN* and <sup>2</sup>*Nagaoka University of Technology, JAPAN*
- TB3.5 *In situ* Measurement of Time-Series Two Dimensional O<sub>2</sub> Distributions at Sediment-Water Interface Using a Planar O<sub>2</sub> Optode System Connected with a Submarine Cable  
K. Ogun<sup>1</sup>, H. Kitazato<sup>1</sup>, R. N. Glud<sup>2</sup>, H. Ståhl<sup>2</sup>, F. Wenzhöfer<sup>3</sup>, K. Asakawa<sup>1</sup>, R. Iwase<sup>1</sup>, S. Sakai<sup>1</sup>, H. Nomaki<sup>1</sup> and K. Fujikura<sup>1</sup>  
<sup>1</sup>*Japan Agency for Marine-Earth Science and Technology, JAPAN*, <sup>2</sup>*University of Copenhagen, DENMARK* and <sup>3</sup>*Max Planck Institute for Marine Microbiology, GERMANY*

**Friday April 20**

**Session FA1: Bio-Mimetic Vehicles**  
**08:20-10:00**

Session Chairs:

Hayato Kondo, *Tokyo University of Marine Science and Technology*  
Sahjendra Singh, *University of Nevada*

- FA1.1 Biologically-Inspired Adaptive Pectoral-Like Fin Control System for CFD Parameterized AUV  
M. S. Naik<sup>1</sup>, S. N. Singh<sup>1</sup> and R. Mittal<sup>2</sup>  
<sup>1</sup>*University of Nevada, USA* and <sup>2</sup>*The Washington University, USA*

- FA1.2** Development of Robotic Fish with Various Swimming Functions  
T. Ichikizaki<sup>1</sup> and I. Yamamoto<sup>2</sup>  
<sup>1</sup>MHI Solution Technologies Co., Ltd., JAPAN and <sup>2</sup>Japan Agency for Marine-Earth Science and Technology, Kyushu University, JAPAN
- FA1.3** Motion Simulation of an Underwater Vehicle with Mechanical Pectoral Fins Using a CFD-based Motion Simulator  
H. Suzuki, N. Kato, T. Katayama and Y. Fukui  
Osaka University, JAPAN
- FA1.4** A Ribbon Like Fin using Electro Conductive Polymer for Precise Motion Control  
K. Sugiyama, K. Ishii and K. Kaneto  
Kyushu Institute of Technology, JAPAN
- FA1.5** Neural Oscillator Based Motion Control System for Snake-Like Robot  
T. Matsuo and K. Ishii  
Kyushu Institute of Technology, JAPAN

**Session FB1: Submarine Cable Application - 2**  
08:20-10:00

Session Chairs:

Hitoshi Mikada, Dept. Civil & Earth Resources Eng., Kyoto University  
Ralph Stephen, Woods Hole Oceanographic Institution

- FB1.1** Synergy Effects of Products and Implementation Solutions for Scientific Submarine Systems and Offshore Oil & Gas Applications  
H. Ottersberg, H. Dirks, W. Rutzen and C. Unger  
Norddeutsche Seekabelwerke GmbH & Co KG, GERMANY
- FB1.2** Fiber Optic 4C Seabed Cable for Permanent Reservoir Monitoring  
S. J. Maas<sup>1</sup> and I. Buchan<sup>2</sup>  
<sup>1</sup>PGS Marine Technology, NORWAY and <sup>2</sup>PGS Asia Pacific Pte Ltd., SINGAPORE
- FB1.3** Monitoring Earthquakes Using Submarine Cables – Transitions from Passive to Active Monitoring –  
H. Mikada<sup>1</sup>, J. Kasahara<sup>2</sup>, T. Watanabe<sup>3</sup>, K. Asakawa<sup>3</sup>, H. Matsumoto<sup>3</sup> and K. Mitsuzawa<sup>3</sup>  
<sup>1</sup>Kyoto University, JAPAN, <sup>2</sup>Japan Continental Shelf Survey Co., Ltd., JAPAN and <sup>3</sup>Japan Agency for Marine-Earth Science and Technology, JAPAN
- FB1.4** Study on the Deployment of Accelerometers in Reflection Seismic Surveys  
H. Takahashi<sup>1</sup>, E. Asakawa<sup>2</sup>, Y. Kawai<sup>3</sup>, Y. Ogasawara<sup>4</sup> and T. Saeki<sup>5</sup>  
<sup>1</sup>OCC Corporation, JAPAN, <sup>2</sup>JGI, Inc., JAPAN, <sup>3</sup>The Nippon Salvage Co., Ltd., JAPAN, <sup>4</sup>Kokusai Cable Ship Co., Ltd., JAPAN and <sup>5</sup>Japan Oil, Gas and Metals National Corporation, JAPAN

**Session FC1: Glider/Hydrodynamics**  
08:20-10:00

Session Chairs:

Masakazu Arima, Osaka Prefecture University  
Fong C Chiu, Department of Engineering Science and Ocean Engineering, National Taiwan University

- FC1.1** Identification of Hydrodynamic Parameters for a Remotely Operated Vehicle Using Projective Mapping Method  
H.-H. Chen, H.-H. Chang, C.-H. Chou and P.-H. Tseng  
National Sun Yat-sen University, TAIWAN
- FC1.2** Pure Yaw Experiments on a Series of Hull Forms for an Underwater Vehicle: Hydrodynamic Observations and Analysis  
F. Azarsina<sup>1</sup>, C. D. Williams<sup>2</sup> and M. T. Issac<sup>1</sup>  
<sup>1</sup>Memorial University of Newfoundland, CANADA and <sup>2</sup>Institute for Ocean Technology, CANADA

- FC1.3 Design of an Underwater Glider with Fore and Aft Buoyancy Engines  
J.-M. Tung, M.-F. Guo, J. Guo, F.-C. Chiu and S.-W. Cheng  
*National Taiwan University, TAIWAN*
- FC1.4 Mathematical Model and Simulation for the Maneuvering Motions of Underwater Gliders  
F.-C. Chiu, M.-F. Guo, M.-Y. Cai, J. Guo, S.-K. Lee and K.-S. Kim  
*National Taiwan University, TAIWAN*

**Session FA2: Behaviors of Fish & Marine Mammals**  
**10:20-12:00**

Session Chairs:

Nobuyuki Miyazaki, *Ocean Research Institute, The University of Tokyo*

Tomonari Akamatsu, *National Research Institute of Fisheries Engineering, Fisheries Research*

- FA2.1 A Ship-Borne Lidar System for Measurement of Ocean Chlorophyll Profiles  
M. Sasano and N. Kiriya  
*National Maritime Research Institute, JAPAN*
- FA2.2 New Approach to Diving Behaviour of Aquatic Animals using Bio-logging System  
N. Miyazaki<sup>1</sup>, K. Sato<sup>1</sup>, Y. Watanabe<sup>1</sup>, K. Aoki<sup>1</sup>, T. Narasaki<sup>1</sup>, T. Kudo<sup>1</sup> and Y. Naito<sup>2</sup>  
<sup>1</sup>*The University of Tokyo, JAPAN* and <sup>2</sup>*Bio-logging Institute, JAPAN*
- FA2.3 Acoustic Counting Method of Upstream Juvenile Ayu *Plecoglossus altivelis* by Using DIDSON  
H. Jun and A. Asada  
*University of Tokyo, JAPAN*
- FA2.4 Quantitative Surveys of Fish Assemblage at a High-Rise Artificial Fish Reef by Stationary Underwater Cameras  
H. Takahashi, A. Matsuda, T. Akamatsu and N. Takagi  
*Fisheries Research Agency, JAPAN*
- FA2.5 Measurement of Swimming Speed in Sperm Whales  
K. Aoki<sup>1</sup>, M. Amano<sup>2</sup>, N. Sugiyama<sup>3</sup>, H. Muramoto<sup>4</sup>, M. Suzuki<sup>5</sup>, M. Yoshioka<sup>6</sup>, K. Mori<sup>7</sup>,  
D. Tokuda<sup>6</sup> and N. Miyazaki<sup>1</sup>  
<sup>1</sup>*The University of Tokyo, JAPAN*, <sup>2</sup>*Teikyo University of Science & Technology, JAPAN*,  
<sup>3</sup>*Sugiyama Giken, JAPAN*, <sup>4</sup>*Marine Micro Technology Inc., JAPAN*, <sup>5</sup>*Little Leonardo Inc., JAPAN*, <sup>6</sup>*Mie University, JAPAN* and <sup>7</sup>*Ogasawara Whale Watching Association, JAPAN*

**Session FB2: Submarine Cable Application - 3**  
**10:20-12:00**

Session Chairs:

Ryoichi Iwase, *JAMSTEC*

Hiroyuki Matsumoto, *JAMSTEC*

- FB2.1 Earthquake Accompanied by Mudflow Observed by a Cabled Observatory off Hatsushima Island in Sagami Bay in April 2006  
R. Iwase<sup>1</sup>, T. Goto<sup>1</sup>, T. Kikuchi<sup>2</sup> and K. Mizutani<sup>3</sup>  
<sup>1</sup>*Japan Agency for Marine-Earth Science and Technology (JAMSTEC), JAPAN*, <sup>2</sup>*National Defense Academy of Japan, JAPAN* and <sup>3</sup>*University of Tsukuba, JAPAN*
- FB2.2 NEMO-SN1 Real-Time Cabled Seafloor Observatory (Southern Italy): Operation Assessment after Two Years from the Deployment and Next Perspectives  
P. Favali<sup>1</sup>, L. Beranzoli<sup>1</sup>, F. Italiano<sup>1</sup> and NEMO Collaboration<sup>2</sup>  
<sup>1</sup>*Istituto Nazionale di Geofisica e Vulcanologia (INGV), ITALY* and <sup>2</sup>*Istituto Nazionale di Fisica Nucleare (INFN), ITALY*
- FB2.3 Offshore Tsunami Observation by the Kuril Islands Earthquake of 15 November 2006  
H. Matsumoto, K. Kawaguchi and K. Asakawa  
*Japan Agency for Marine-Earth Science and Technology, JAPAN*

**Session FC2: Navigation Control of Vehicles**

**10:20-12:00**

Session Chairs:

Shojiro Ishibashi, *Japan Agency for Marine-Earth Science and Technology*

Kjetil B. Anonsen, *University Graduate Center (Unik)*

- FC2.1 Low Altitude Tracking of Rugged Seafloors for Autonomous Visual Observation  
T. Maki<sup>1</sup>, T. Ura<sup>1</sup>, H. Mizushima<sup>2</sup>, H. Kondo<sup>3</sup>, T. Sakamaki<sup>1</sup> and M. Yanagisawa<sup>2</sup>  
<sup>1</sup>The University of Tokyo, JAPAN, <sup>2</sup>Waseda University, JAPAN and <sup>3</sup>Tokyo University of Marine Science and Technology, JAPAN
- FC2.2 The Rotation Control System to Improve the Accuracy of an Inertial Navigation System Installed in an Autonomous Underwater Vehicle  
S. Ishibashi<sup>1</sup>, S. Tsukioka<sup>1</sup>, T. Sawa<sup>1</sup>, H. Yoshida<sup>1</sup>, T. Hyakudome<sup>1</sup>, J. Tahara<sup>1</sup>, T. Aoki<sup>1</sup> and A. Ishikawa<sup>2</sup>  
<sup>1</sup>Japan Agency for Marine-Earth Science and Technology, JAPAN and <sup>2</sup>Nippon Marine Enterprises, LTD., JAPAN
- FC2.3 Bayesian Terrain-Based Underwater Navigation Using an Improved State-Space Model  
K. B. Anonsen<sup>1</sup>, O. Hallingstad<sup>1</sup> and O. K. Hagen<sup>2</sup>  
<sup>1</sup>Norwegian University of Science and Technology, NORWAY and <sup>2</sup>Norwegian Defence Research Establishment (FFI), NORWAY
- FC2.4 Self-Organizing Decision-Making System for AUV  
S. Nishida<sup>1</sup>, K. Ishii<sup>2</sup> and T. Furukawa<sup>2</sup>  
<sup>1</sup>The University of Kitakyushu, JAPAN and <sup>2</sup>Kyushu Institute of Technology, JAPAN
- FC2.5 Motion Planning for Small Formations of Autonomous Vehicles Navigating on Gradient Fields  
S. Kalantar and U. Zimmer  
*Australian National University, AUSTRALIA*

**Session FA3: Bio-Sonar**

**13:00-15:00**

Session Chairs:

Rajendar Bahl, *Indian Institute of Technology, Delhi*

Masanori Kyo, *JAMSTEC*

- FA3.1 Comparison of Echolocation Behaviour between Coastal and Riverine Porpoises  
T. Akamatsu<sup>1</sup>, J. Teilmann<sup>2</sup>, L. A. Miller<sup>3</sup>, J. Tougaard<sup>2</sup>, R. Dietz<sup>2</sup>, D. Wang<sup>4</sup>, K. Wang<sup>4</sup>, U. Siebert<sup>5</sup> and Y. Naito<sup>6</sup>  
<sup>1</sup>National Research Institute of Fisheries Engineering, JAPAN, <sup>2</sup>National Environmental Research Institute, DENMARK, <sup>3</sup>University of Southern Denmark, DENMARK, <sup>4</sup>Chinese Academy of Sciences, CHINA, <sup>5</sup>University of Kiel, GERMANY and <sup>6</sup>National Institute of Polar Research, JAPAN
- FA3.2 Estimated Beam Pattern and Echolocation Characteristics of Clicks Recorded from a Free-Ranging Ganges River Dolphin  
T. Ura<sup>1</sup>, R. Bahl<sup>2</sup>, H. Sugimatsu<sup>1</sup>, J. Kojima<sup>3</sup>, T. Inoue<sup>1</sup>, T. Fukuchi<sup>4</sup>, S. Behera<sup>5</sup>, A. Pattnaik<sup>6</sup>, M. Khan<sup>6</sup>, S. Kar<sup>7</sup>, C. S. Kar<sup>7</sup> and D. Swain<sup>8</sup>  
<sup>1</sup>The University of Tokyo, JAPAN, <sup>2</sup>Indian Institute of Technology Delhi, INDIA, <sup>3</sup>KDDI R&D Laboratories Inc., JAPAN, <sup>4</sup>System Giken Co., Ltd., JAPAN, <sup>5</sup>WWF-India, INDIA, <sup>6</sup>Chilika Development Authority, INDIA, <sup>7</sup>Office of the Principal CCF (Wildlife) & Chief Wildlife Warden, INDIA and <sup>8</sup>Simpilipal Biosphere and Tiger Reserve, Orissa, INDIA
- FA3.3 Compensation Behaviors in Echolocating Bats Measured by a Telemetry Microphone during Flight  
S. Hiryu, T. Hagino, Y. Shiori, H. Riquimaroux and Y. Watanabe  
*Doshisha University, JAPAN*

- FA3.4 Analysis of the Echo for Identifying the Temporal Structure of the Fish by using the Broadband Sonar Signal of Dolphin  
I. Matsuo<sup>1</sup>, T. Imaizumi<sup>2</sup>, M. Furusawa<sup>2</sup>, T. Akamatsu<sup>3</sup>, Y. Nishimori<sup>4</sup> and S. Ogawa<sup>4</sup>  
<sup>1</sup>Tohoku Gakuin University, JAPAN, <sup>2</sup>Tokyo University of Marine Science and Technology, JAPAN, <sup>3</sup>Fisheries Research Agency, JAPAN and <sup>4</sup>Furuno Electric Co., Ltd., JAPAN
- FA3.5 Measurements of Target Strength Spectra of Metal Spheres and Live Fish by using Broad Band Sonar Signals of Dolphin  
T. Imaizumi<sup>1</sup>, M. Furusawa<sup>1</sup>, T. Akamatsu<sup>2</sup> and Y. Nishimori<sup>3</sup>  
<sup>1</sup>Tokyo University of Marine Science and Technology, JAPAN, <sup>2</sup>Fisheries Research Agency, JAPAN and <sup>3</sup>Furuno Electric Co., JAPAN
- FA3.6 High-Frequency Acoustic Recording Package (HARP) for Broad-Band, Long-Term Marine Mammal Monitoring  
S. M. Wiggins and J. A. Hildebrand  
Scripps Institution of Oceanography, USA

**Session FC3: Vehicle Control/Swarms**  
**13:00-15:00**

Session Chairs:

Øyvind Hegrenæs, *Norwegian University of Science and Technology*

Uwe R. Zimmer, *The Australian National University*

- FC3.1 Comparison of Mathematical Models for the HUGIN 4500 AUV Based on Experimental Data  
Ø. Hegrenæs<sup>1</sup>, O. Hallingstad<sup>1</sup> and B. Jalving<sup>2</sup>  
<sup>1</sup>Norwegian University of Science and Technology, NORWAY and <sup>2</sup>Kongsberg Maritime, NORWAY
- FC3.2 Development of an Open Architecture Controller for a Commercial AUV  
S. H. Ji<sup>1</sup>, Y. S. Jung<sup>1</sup>, B. H. Lee<sup>1</sup>, J. S. Woo<sup>2</sup> and Y. S. Joo<sup>2</sup>  
<sup>1</sup>Seoul National University, KOREA and <sup>2</sup>DSME UTech Co., Ltd., KOREA
- FC3.3 Design and Fabrication of a Small Test-Bed Aimed for Basin Experiment of Underwater Multi-Agent System  
K. Watanabe  
*Tokai University, JAPAN*
- FC3.4 Optimal Control of an Underwater Vehicle with Single Actuator  
M. S. Arsla, N. Fukushima and I. Hagiwara  
*Tokyo Institute of Technology, JAPAN*
- FC3.5 Relative Localisation for AUV Swarms  
N. Kottege and U. R. Zimmer  
*The Australian National University, AUSTRALIA*
- FC3.6 Pruning Local Schedules for Efficient Swarm Communication  
F. Schill and U. Zimmer  
*Australian National University, AUSTRALIA*