



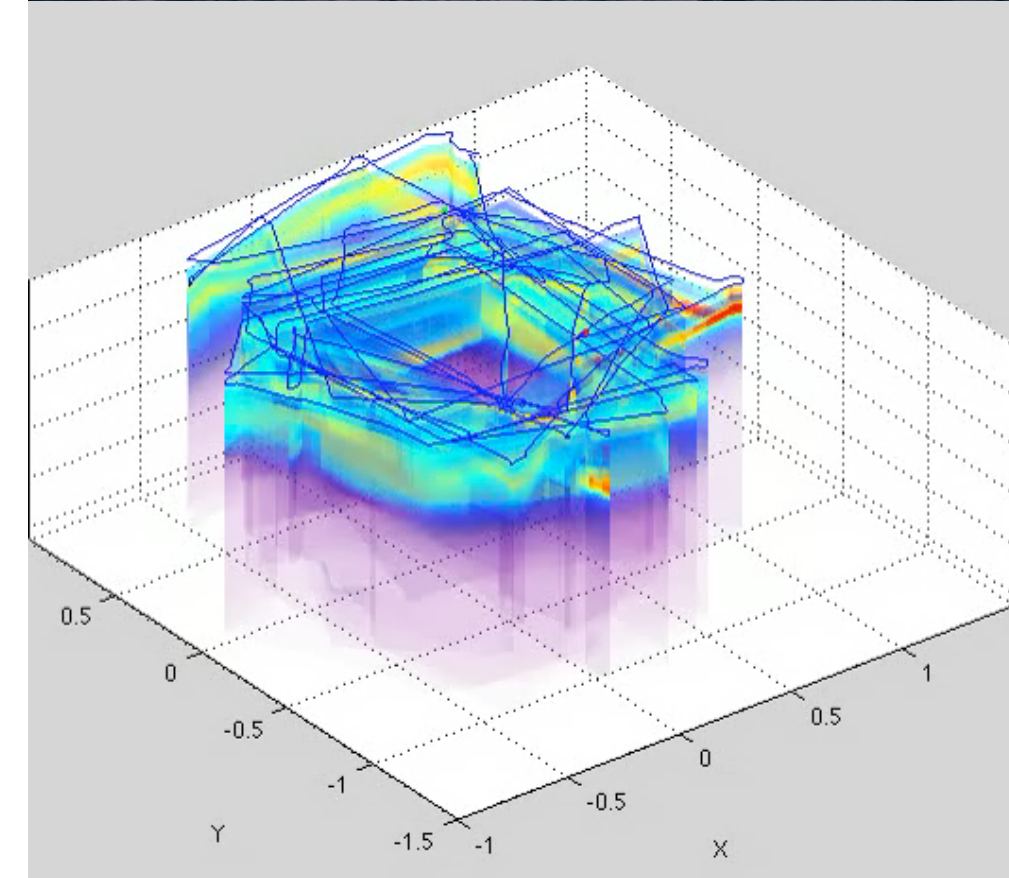
Autonomy Project Plans for 2011

Kanna Rajan
Jan 10th

Looking back at 2010

- Continued development of T-REX for new applications
 - Core engine development minimal
 - Model development focused on applications
 - Drifter tracking (Sept)
 - Overnight missions (Oct)
 - Chasing a chlorophyll patch (Oct)
- Design/Requirement gathering/advocacy/development of the DSS
 - concept enshrined with prototype from JD
 - actual engineering development from 2011-?
- Collaborations
- Publications

- [Simultaneous Tracking and Sampling of Dynamic Oceanographic Features with Autonomous Underwater Vehicles and Lagrangian Drifters](#) J. Das, **F. Py**, T. Maughan, T. O'Reilly, M. Messie, J. Ryan, **K. Rajan** and G. Sukhatme 12th Int'l Symp. on Experimental and Robotics (ISER) Dec 2010, New Delhi, India.
- [Mobile autonomous process sampling within coastal ocean observing systems](#). J. P. Ryan, S.B. Johnson, A. Sherman, **K. Rajan**, **F. Py**, H. Thomas, J.B.J. Harvey, L. Bird, J.D. Paduan & R. C. Vrijenhoek, *Limnology Oceanography: Methods* 8, 2010, 394-402
- [Randomized Testing for Robotic Plan Execution for Autonomous Systems](#). Z. Saigol, **F. Py**, **K. Rajan**, **C. McGann**, J. Wyatt & R. Dearden. *IEEE Autonomous Underwater Vehicles 2010*, September 2010, Monterey, California.
- [Adaptive Control of AUVs Using Onboard Planning and Execution](#). **K. Rajan**, **F. Py** & **C. McGann**, Sea Technology April May (Non peer-reviewed magazine article)
- [A Systematic Agent Framework for Situated Autonomous Systems](#). **F. Py**, **K. Rajan** & **C. McGann**. *9th Int. Conf. on Autonomous Agents and Multiagent Systems (AAMAS)*, May 2010, Toronto, Canada.
- [Towards Marine Bloom Trajectory Prediction for AUV Mission Planning](#). J. Das, **K. Rajan**, S. Frolov, J. Ryan, **F. Py**, D. Caron & G. Sukhatme. *IEEE International Conference on Robotics and Automation (ICRA)*, May 2010, Anchorage, AL.



Looking back at 2010

- 3D gridded simulation progress
 - Incomplete -- need integration with actual AUV (Linux) Sim
- MC-FSim
 - Incomplete -- lack of time and general dyslexia
- SmartSampler
 - Not started -- lack of time and distractions
- Stabilizing T-REX versions
 - Ongoing -- stretch goal

2010 Kick-off slide

Expected Deliverables

- **Requirements discovery**
 - Preliminary design document for sampling
- **Decision Support tools for CANON**
 - Model synthesis (biological, physical and advection)
 - Agglomeration of above to provide tools/techniques to allow scientists on shore to determine where/when we place an asset
- **Simulation and Modeling**
 - Synthesis of model outputs
 - Integration of synthetic modeling for AUV simulation

?



2011 Project Proposal Summary

1. Coordinate and integrate Planning/Learning into DSS and its subcomponents
 - Integrate Planning and Learning components into the DSS
2. Coordinating asset sampling and planning
 - Work within the CANON framework for planning experiments
3. Machine Learning for event-response
 - Use of tagging and offline learning to flag evolving events in the coastal ocean
 - Use of incoming data stream as a means to categorize data
4. Generating constraint-based plans for field deployments
 - First steps in building constraint-based plans for managing asset deployments for CANON
5. Investigate composition of Machine Learned models (with Maria Fox)
 - Current use of HMM and clustering models have single feature focus
 - To independently build and compose feature models for onboard encapsulation



So what is needed for 2011?



Onboard



Off-board

- Interruptible Surveys
 - Allow opportunistic science goals to be inserted
 - Existing goals are simply put in abeyance, not discarded
 - Allows scientists from shore to inject new objectives which can be prioritized in-situ
- SmartSampler
 - Our story is poor to non-existent in sampling; improve sampling and show comparatively performance
 - Decouple sampling from TREN so one is not completely dependent on the other
- Full-functional 4D sim environment
 - Original notion of simulating dynamic coastal environments with synthetic model snapshots
 - Functional system to mimic fronts and advecting bloom patches
 - Journal/conf. paper
- DSS Event response
 - Use ML, tagged data and supervised/semi-supervised approaches to flag dynamic events from near real-time data/streams
- Coordinating Plans for assets
 - Generate plan scripts and visualize
 - Compare planned and actual runs of AUV within the DSS
- Distributed Planning & Adaptive Field Sampling
 - Open research problem: how can diverse assets be constrained to act as a whole?
 - How to represent dynamics of a field within the DSS for adaptive sampling?
 - How can off-shore support/tools/process impact onboard performance and sampling quality?



(replaces all preliminary revs.)

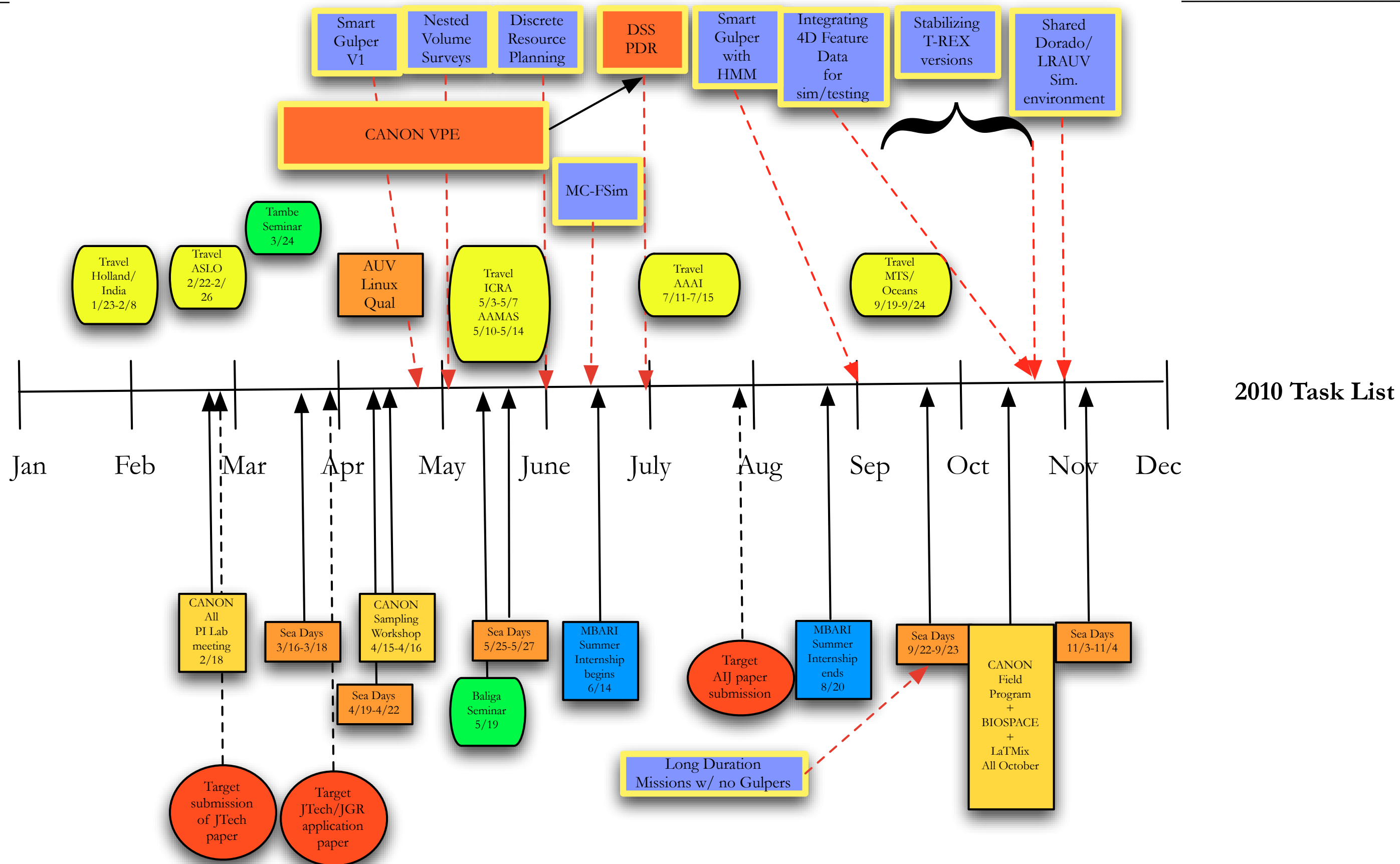
2011 Sea Days

MBARI 2011

R/V Western Flyer, Point Lobos, Zephyr

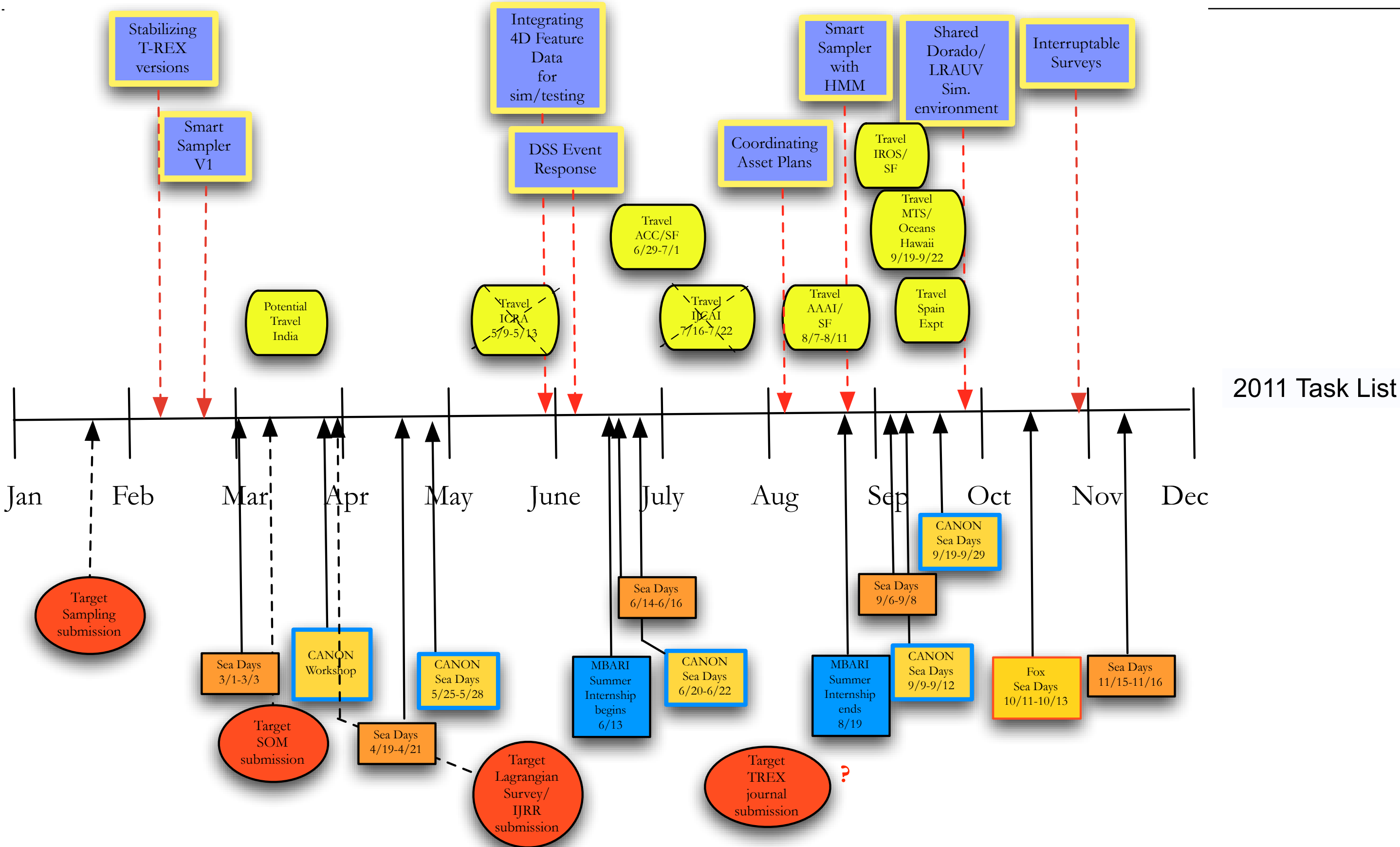
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Flyer										Audit-V																DMO	DMO					Flyer
Zephyr										No ops								No ops							Robison	Kelley	MOOS				Hobson	Zephyr
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Flyer														Barry (4)										MARS-OM							Flyer	
Zephyr	Rock																											Kelley			Zephyr	
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Lobos	Brewer	Brewer	Barry						Chavez						Brewer	Brewer					MSTF	MSTF	MSTF	MSTF				Chavez	BRS	Barry	Lobos	
Flyer														Robison (7)													Haddock (7)				Flyer	
Zephyr			Rajan 24-hr (3)						Kelley	MOOS					Rock	Hobson												AUV Testing (at sea)			Smith	Zephyr
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Zephyr									Rock	Hobson	ESP																					Zephyr
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Flyer																																Flyer
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Lobos																																Lobos
Flyer																																Flyer

Potential tasks/deliverables





Potential tasks/deliverables





Output for today

- Agree on overall schedule and deliverables
- Start thinking thru on planning/ML interactions with DSS
 - Early interaction with DSS engineering team essential
 - July is demo time for MT
- Target travel for conferences:
 - ~~Intl. Conf. on Robotics and Automation 2011, Shanghai~~
 - ~~Intl. Joint Conf. on AI 2011, Barcelona~~
 - American Control Conference, San Francisco
 - MTS/Oceans, US location to be announced
 - Assoc. for the Adv. For AI (AAAI), national conference, San Francisco
- Determine vacation/travel dates for all