BAE

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2

Added by Zweidler, Stephan Austin (ARC-TI)[ARC-TI-Collaborative], last edited by Pukite, Paul R [BAE Systems] on Oct 09, 2012 (view change)

BAE SYSTE

Hierarchy

- Environmental Context Modeling
  - Clutter Modeling
  - Context Fixed Obstacles
  - Context Modeling task list 1
  - Context Model Interfacing
  - Context Model Test Procedures
  - ContextStandards
  - Corrosion and Oxidation
  - Environmental Context Modeling Ontology
    - EnvironmentalContextGeospatial
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      - SemanticContextArchitectureOscar
    - Semantic Context Language Requirements
      - SemanticContextArchitectureDynamic
    - SWEET
  - Environmental Context Requirements
  - Fine Terrain Features
    - OpenCRG
    - TOPS
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  - Lake Size Statistics
  - Particle Size Statistics
  - Probabilistic formal model checking
  - Rainfall Statistics
  - SemanticContextWeb
  - Stochastic Models
    - Dispersion Characterization
    - Environmental

BAE Systems is responsible for context modeling of the vehicle environment.

Contents

The BAE working area is in Environmental Context Modeling

Work Scope

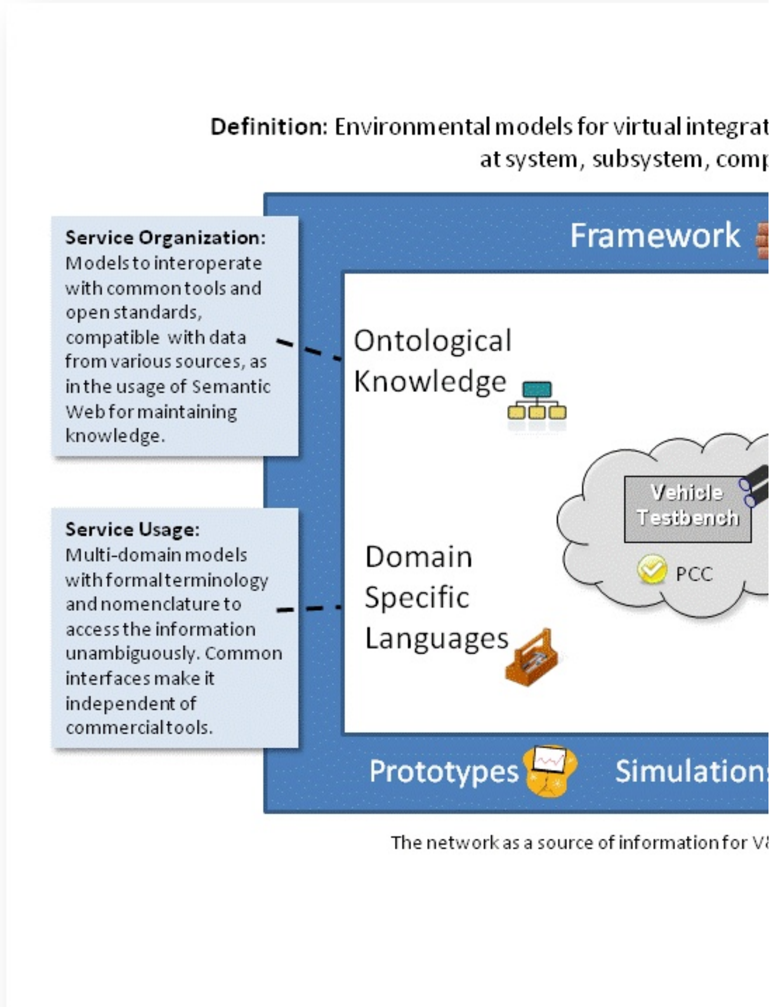
The principal focus of this technical area is on exogenous contexts applicable at all levels of abstraction to drivetrain and mobility subsystems of an infantry fighting vehicle with amphibious considerations. Of specific interest under this technical area are terrain (to include land and water), atmosphere, thermal, moisture, corrosion, and foreign particulates models.

- *Terrain models are expected to represent the surface/fluid that an amphibious infantry fighting vehicle would traverse, ranging from paved road surfaces to rocky, mountainous terrain, slope, discrete obstacles (such as step climbs, v-ditches, etc.), mud, sand, snow, and water fording (both salt water in a ship-to-shore deployment typical of a Marine Air-Ground Task Force, as well as fresh or coastal water for river/lake/etc. fording). Additionally, surface curvature and forward- as well as side-sloping should be incorporated. Context models for amphibious locomotion should include overcoming various water-borne mobility elements of drag, hydrostatic and hydrodynamic performance, operations in both calm water and sea states with wave heights up to 3 feet. The models should specify in detail the modality of interaction between the environment and the specific elements of the drivetrain and mobility subsystems which it affects.*

- *Atmosphere and moisture models provide an ambient thermal, photonic, salt water, and humidity environment within which the mobility and drivetrain subsystems must function, and their interaction with the constituent elements of the vehicle subsystems.*

- *Particulates models of interest include atmospherically-borne particulate matter such as dust, sand, snow, ice particles, water-borne particulates (when submerged during amphibious transit), and volcanic ash, and their interaction with the mobility and drivetrain subsystems.*

- [Model Artifacts]
  - [Probability Elements]
  - [Terrain Spectroscopy]
- [Thermal Dispersion]
- [Wave Energy Statistics]
- [Wind Energy Statistics]



Context Map

BAE	Clutter Modeling
ContextMod el- sCSIR	ContextStan d- ards
Environment a- l Context Modeling Ontology	Environment a- l Context Requiremen t- s
OpenCRG	Particle Size Statistics
Semantic Context Architectur- e	SemanticCo nt- extArchitect u- reOscar
Thermal Dispersion	TOPS

Labels context

1 Child Page

Environmental Context Modeling

Write a comment…

Environmental Context Modeling

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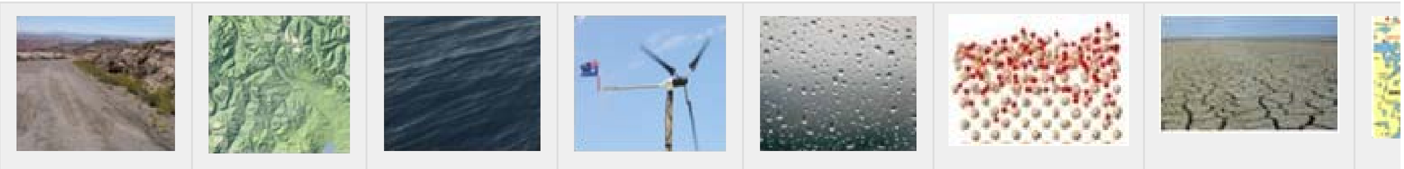
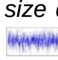
24 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Nov 26, 2012 (view change)



- Index
- Overview
  - Description of Deliverables
  - Managing work
- References

Index

- Architecture
  - Ontology - plan / work - *Semantic classification, search, and service composition approaches*
  - Stochastic Patterns - plan / work - *Fundamental probability and statistics models of the environment*
  - Interfaces - plan / work - *Interoperability for testbench configurations*
  - Artifacts - plan / work - *Metrics and modeling artifacts for curation*
- Land
  - Fine Terrain Features - plan / work - *Methods for modeling spatial frequencies for power spectral densities (PSD)*
  - Gross Terrain Features - plan / work - *Simple distribution for sampling likelihood of terrain slopes*
- Aquatic
  - Wave Energy Statistics - plan / work - *Simple approach for generating PSD's and sea-state data*
  - Lake Size Statistics - plan / work - *Maximum entropy estimation for lake size distributions for regions*
- Atmospheric
  - Wind Energy Statistics - plan / work - *General results for modeling wind energy distribution and autocorrelations for persistence*
  - Rainfall Statistics - plan / work - *General model for rainfall distributions within storms using composite process, clouds*
  - Corrosion and Oxidation - plan / work - *Model of oxidation and corrosion growth*
  - Thermal Dispersion - plan / work - *Simplification of thermal diffusion model to account for disorder and variability in the media.*
  - Particle Size Statistics - plan / work - *General method for modeling size distribution of particulates such as ash and ice crystals*
  - Clutter Modeling - plan / work - *Maximum entropy models for E-M signals and noise, lightning*

Search

Expand all Collapse all

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- Stochastic Models
- Thermal Dispersion
- Wave Energy Statistics
- Wind Energy Statistics

- Environmental Context Requirements
  - Natural Environment
    - Standards
    - Modality of interaction
      - Fixed models (static, passive)
      - Compliant models (deforming, feedback)
    - Statistical
      - Nominally fluctuating
      - Extreme Values
  - Man-Made
    - Deterministic (Context Fixed Obstacles)
    - semi-Markov (quasi-periodic, see ContextModelsCSIR for examples such as Belgian Block and corrugated tracks)
  - Vehicle Requirements
    A factory-like workflow is configured to guide the user to the models needed for verifying vehicle requirements.

- Test & Verification
  - Probabilistic formal model checking
  - Test Procedures
  - Testbench examples
- Installation
  - SemanticContextWeb

Overview

In response to DARPA's drive to develop a radically innovative approach to the development of military vehicles, resulting in significant reductions in the cost and schedule required to do so, a novel approach to the model-based verification of vehicles is required. In support of that goal, and in response to C2M2L-1 Technical Area 2, we propose to build a virtual mobility Test Bed for AVM. The AVM Test Bed will consist of a comprehensive suite of environmental context models necessary to thoroughly test the model-based mobility and drivetrain systems of a land-based or an amphibious Infantry Fighting Vehicle (IFV).

Description of Deliverables

- A comprehensive suite of environmental context models that are necessary to thoroughly test the mobility and drivetrain component models, and subsystems composed of the models, as delivered by the Technical Area 1 performers.
- A comprehensive set of use cases/mobility verification requirements for testing land-based and amphibious mobility systems and drivetrains intended to illustrate use of the models to META performers and users and to test the models provided.
- Information used to formulate each context models, which also will be used to quantify the uncertainty of each model delivered.
- Executable examples illustrating the use of each of the context models the BAE Systems team synthesizes and delivers. The executable examples will be used to verify the context models. The examples will also provide the META development community with detailed information about how to use and verify the context models.
- A semantic web based executable architecture based on the Semantic Web Earth and Environmental (SWEET) ontology populated with translatable representations of the context models, information used to construct the models, examples of model use, and methods for translating the models.
- Utilities necessary to search and manipulate the ontology of context models and facilitate translation of the models.
- Novel methods for constructing adaptable models.
- A template of a test article, called the Virtual Automotive Test Rig (VATR), that will assist META in performing design verification.

Managing work

- Context Modeling task list 1

References

1. Previous META work here. This has information on modeling and simulation for PCC.

Labels None

20 Child Pages

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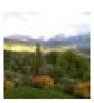

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Clutter Modeling

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1 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Nov 20, 2012 (view change)

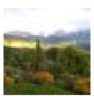
Intro

The foundation for this work is described in the Probability Elements white paper.

EMI effects

EMI modeling document

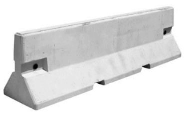
Labels context



Write a comment…

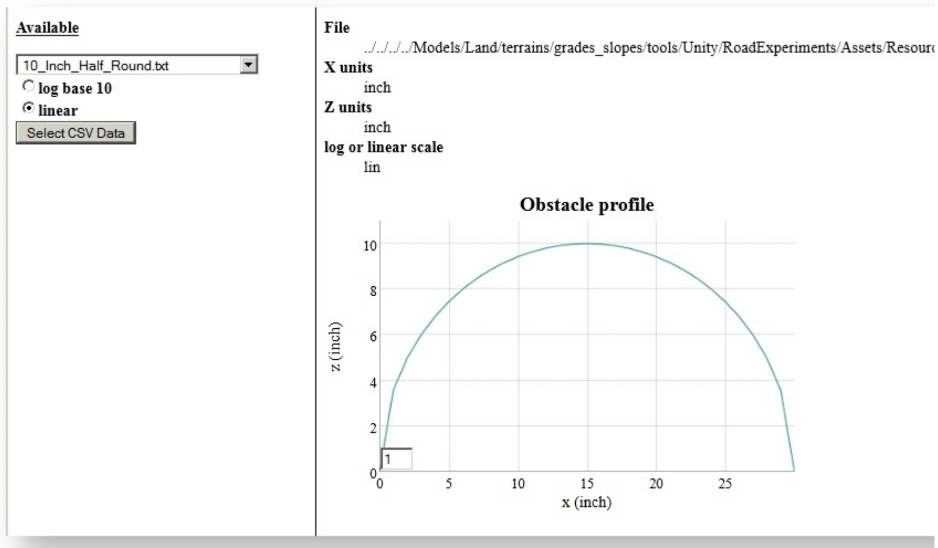
Context Fixed Obstacles

5 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 24, 2012 (view change)

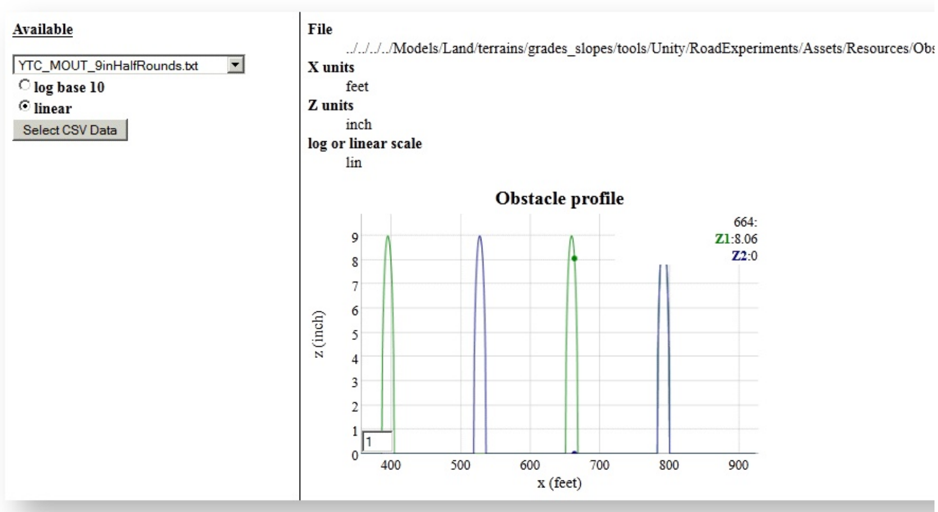


Fixed obstacles are specified by either a 1D track profile or a pair of 1D track profiles in the case of cross slopes.

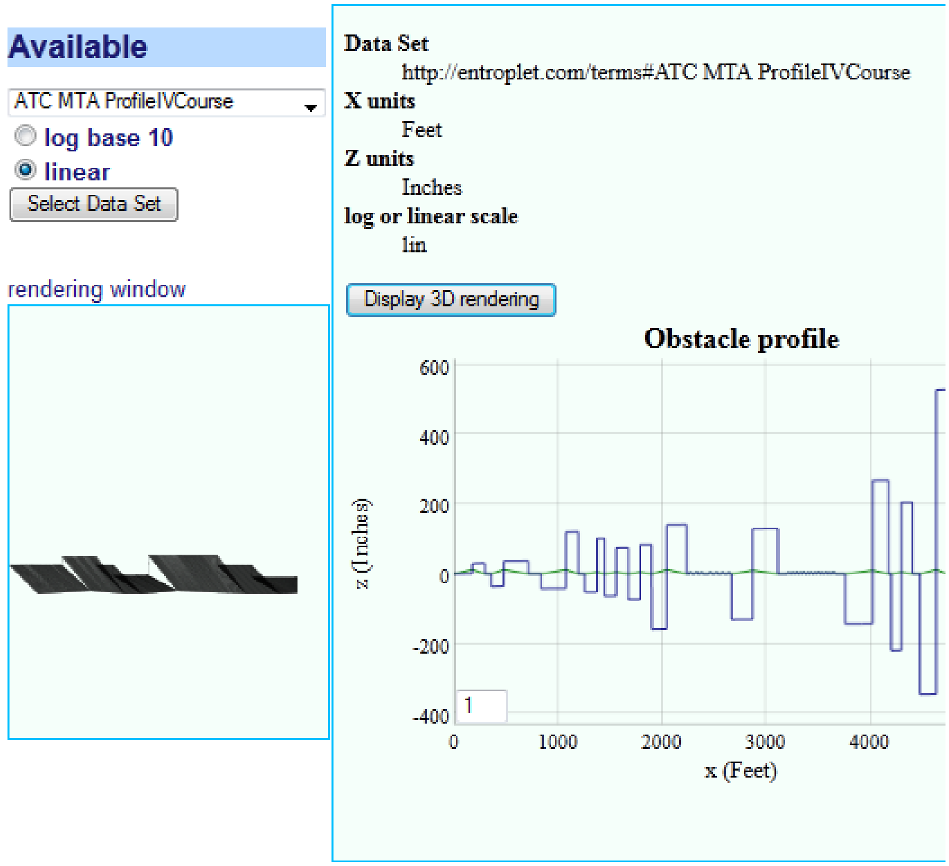
One dimensional obstacle profile



A pair of 1D profiles

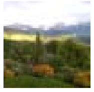


3D Rendering view



version 2:

Labels None



Write a comment…

Context Modeling task list 1

Edit Share Add Tools

1 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Oct 03, 2012 (view change) show comment

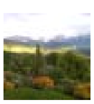
First task list

Add

- [ ] Pull TOPS and other requirements documents into citation system, partially complete
- [ ] Add physical constants and properties to the knowledgebase
- [ ] Plan for use of AVM SVN repository, Ontology subdirectory in place, Models need to be updated
- [ ] Integrate smaller models (buoyancy, temperature, etc) into ontology
- [ ] Change file names to not use % or other characters that do not operate well over operating systems
- [ ] Set up a cloud evaluation platform to run the semantic server on, initial evaluation version running, see PP
- [ ] Create synthetic representations of CSIR track data via the superposition of sine approach
- [ ] On cloud server, the R images such as PNG, BMP, JPG don't work. Look for a more recent R package
- [ ] Simple testing infrastructure for semantic web calls

Sort by: Custom

Labels context



Write a comment…

Context Model Interfacing

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Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Jul 11, 2012 (view change)

Interface Categories

Most of the environmental context models have similar patterns, in that they possess salient characteristics that follow standard representations such as probability density functions (PDF), power spectral densities (PSD), and amplitude profiles. Since these are standard formulations, they can be aggregated and distilled through a common pattern and reuse framework.

Standalone or embedded models

The model is delivered inside executable code that is linked to a vehicle simulation testbench. The agreed upon standard is the Functional Mockup Interface, although other approaches include S-functions in Matlab, and general compiled C-code or interpreted embedded Python.

Served models

The model resides on a web server hosted on a cloud computing environment. Information is served for Monte Carlo simulations run by clients that can interface through a web service. Organization is provided by the Environmental Context Modeling Ontology semantic web back-end which keeps track of the models available.

The standalone/embedded models can be potentially generated from a reasoner which uses information on algorithms and data to construct the necessary code.

Data file models

Data files are either delivered through a web service or file server, with the semantic web service again providing organization above that a file server will provide.

Model artifacts (graphs, visuals, etc)

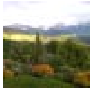
Artifacts for models can include interactive PSD and PDF charts, and generated Monte Carlo profiles. These are useful for the user to understand the ranges, extreme values, and severity of the various models.

More elaborate are context model visualizations which can include 3D rendering of terrains and sea-scapes.

Model metrics

Similar to artifacts, metrics contain auxiliary meta-information on models such as maturity and potentially complexity, which will be useful for model curation activities.

Labels context context



Write a comment…

Context Model Test Procedures

3 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 11, 2012

Functional Mockup Interfaces

In preparation for using the FMU the BAE Systems Context Model installer must be run to install the needed files on the target machine.To import the FMUs into OpenModelica you must do the following:

1. If the install program required administrator access rights that are not available in the current ID you must copy the FMUs from C:\BAE Systems\ContextModelExamples\Modelica\Fmu into another directory such as C:\fmu.
2. Start OpenModelica Connection Editor.
3. Select the menu item FMI>>Import FMI
   See Figure 1 to the right
4. Click the Browse button and browse to the FMU you wish to import (i.e. C:\fmu\SpectralTerrain.fmu).
5. Click the Output Directory Browse button and select a directory to expand the FMU such as C:\fmu\import.
   See Figure 2 to the right
6. Click the Import Button.
7. Change the Working Directory in the Tool>>Options menu item to the resources directory of the expanded FMU(i.e. C:\Fmu\import\resources)
8. Open the example that matches the imported FMU such as C:\BAE Systems\ContextModelExamples\Modelica\Models\TerrainCrawler.mo
9. Select the example model in the Modelica Files panel.
10. Click the green simulate arrow. This will cause the OMEdit –

Figure 1

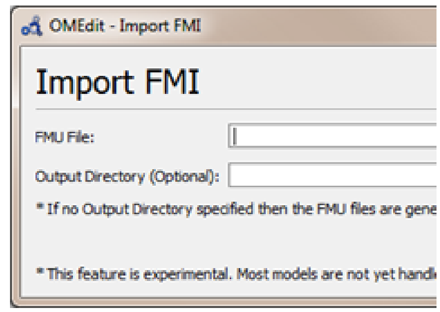


Figure 2

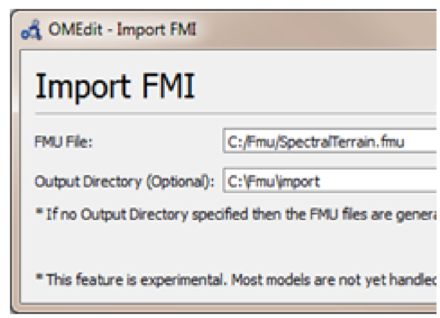
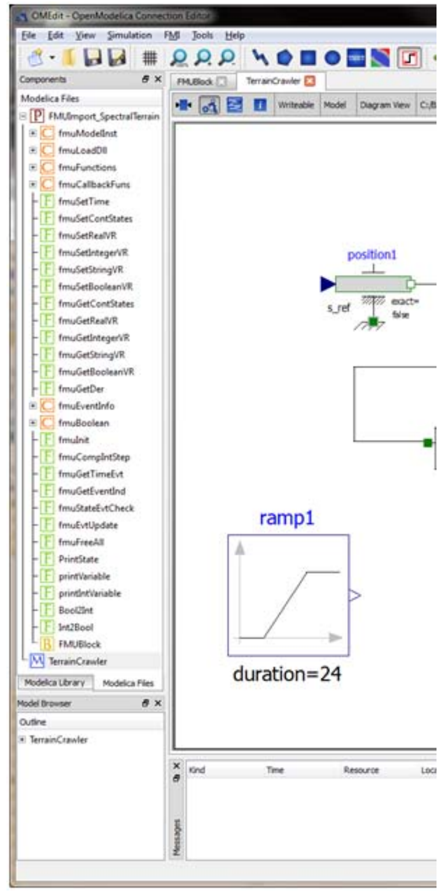


Figure 3

Simulation dialog to appear.

11. Click the Simulate button in the OMEdit – Simulation dialog.
12. In the resulting plot you can see the generated in the fmublock1.Zed variable. ***See Figure 3 to the right***



Labels None

Write a comment…

ContextStandards

1 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Nov 26, 2012 (view change)

Environment Standards	Standards such as TOPS and AR 70-38 apply. This spreadsheet extracts tabular information from the AR-70-38 doc: AR-70-38.xlsx

Labels context

Write a comment…

Corrosion and Oxidation

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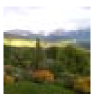
2 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Nov 26, 2012 (view change)

Intro

The foundation for this work is described in the Dispersion Characterization white paper.

This spreadsheet contains the model: corrosion.xlsx

Labels context



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Environmental Context Modeling Ontology

Edit Share Add Tools

2 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 20, 2012 (view change)

We are working out the organizational strategy for the context model ontology. The main categories are for environmental descriptions (SWEET), geospatial coordinates, and meta reference material (which can include citations, requirements, etc).

Information Sources

- Physical constants such as water density, gravitational constant
- Lookup tables such as soil types, sea-states
- Dimensional units such as SI
- Geospatial definitions and schema – Environmental Context Geospatial
- Context data sources
  1. Verification & Requirements documents such as TOPS (Test Operating Procedures)
  2. Earth sciences archives such as NASA JPL PO.DAC, US Army Corps of Engineers WIS, etc
- Meta-information: Citations and references for models, algorithms, requirements

Ontology and Vocabulary Candidates

- SWEET 2.3: http://sweet.jpl.nasa.gov/2.3/ [cross-walk analysis of sweet layers : xlsx]
- Instance data http://example.org
- Biblio http://purl.org/net/biblio
- FOAF (Friend of a Friend) http://xmlns.com/foaf/spec/index.rdf
- SKOS (Simple Knowledge Organization System) http://www.w3.org/2004/02/skos/core RDF http://www.w3.org/2009/08/skos-reference/skos.rdf
- Open GIS http://www.opengis.net/def/
- Geospatial Query http://schemas.opengis.net/geosparql/1.0/geosparql_vocab_all.rdf
- CommonTag http://commontag.org/ns
- Bibliographic Ontology http://purl.org/ontology/bibo/ OWL http://bibotools.googlecode.com/svn/bibo-ontology/tags/1.3/bibo.xml.owl#
- Vocabulary http://purl.org/vocab/
- SWORE (Semantic Web Ontology for Requirements Engineering) http://ns.softwiki.de/req/?format=html RDF http://ns.softwiki.de/req/?format=rdfxml
- SIOC (Semantically-Interlinked Online Communities) http://sioc-project.org/ontology/
- PRISM (Publishing Requirements for Standard Industry Metadata) http://prismstandard.org/namespaces/1.2/basic/
- Platform Ontology work: http://marinemetadata.org/community/teams/ontplatforms OWL http://mmi.svn.sourceforge.net/svnroot/mmi/mmisw/platform.owl
- Device Ontology work: http://marinemetadata.org/community/teams/ontdevices
- W3C Semantic Sensor Incubator: http://www.w3.org/2005/Incubator/ssn/
- VSTO Ontologies: http://vsto.org/forward.htm?forward=ontology
- Sindice - Data Web Services: http://sindice.com/

Ontology Terms

- GCMD instruments: http://gcmd.nasa.gov/KeywordSearch/Keywords.do?KeywordPath=Instruments
- GCMD platforms: http://gcmd.nasa.gov/KeywordSearch/Keywords.do?KeywordPath=Platforms
- NASA Taxonomy of Instruments: http://nasataxonomy.jpl.nasa.gov/2.0/instruments/
- NASA Taxonomy of Missions/Projects: http://nasataxonomy.jpl.nasa.gov/2.0/missionsprojects/

Ontology Architectures

- Semantic Context Architecture
- Semantic Context Language Requirements
- Zotero Reference Management system

Ontology References

- Watson ontology search engine: http://watson.kmi.open.ac.uk/WatsonWUI/
- Swoogle ontology search engine: http://swoogle.umbc.edu
- MMI Overview of controlled vocabularies: http://marinemetadata.org/guides
- MMI Ontology Registry: http://mmisw.org/or
- MMI Overview of ontology tools: http://marinemetadata.org/guides/vocabs/ontologies/ontsoftware
- OOSTethys: http://www.oostethys.org
- Open Geospatial Consortium : http://www.opengeospatial.org/
- GMU Geospatial : http://www.laits.gmu.edu/geo/nga/index.html

Ontology Tools

- RDF converter http://www.mindswap.org/2002/rdfconvert/
- Google Refine data translator: http://code.google.com/p/google-refine/
- Google Refine RDF extension: http://refine.deri.ie/

Ontology Elements

We will need to start collecting key terms that we can use to semantically link artifacts with.

Subject	Predicate	Object
dcterms:isRequiredBy	rdfs:comment	"A related resource that requires the described resource to support its function, delivery, or coherence."@en-US
dcterms:requires	rdfs:label	"Requires"@en-US
dc:subject	dcterms:description	"Typically, the subject will be represented using keywords, key phrases, or classification codes. Recommended best practice is to use a controlled vocabulary. To describe the spatial or temporal topic of the resource, use the Coverage element."@en-US
dcterms:hasVersion	rdfs:comment	"A related resource that is a version, edition, or adaptation of the described resource."@en-US
dcterms:hasFormat	rdfs:comment	"A related resource that is substantially the same as the pre-existing described resource, but in another format."@en-US
dcterms:source	rdfs:comment	"A related resource from which the described resource is derived."@en-US
dcterms:hasPart	rdfs:comment	"A related resource that is included either physically or logically in the described resource."@en-US
dcterms:description	dcterms:description	"Description may include but is not limited to: an abstract, a table of contents, a graphical representation, or a free-text account of the resource."@en-US
dcterms:provenance	dcterms:description	"The statement may include a description of any changes successive custodians made to the resource."@en-US
rdfs:comment	rdfs:comment	"A description of the subject resource."
rdfs:label	rdfs:label	"label"
reprMathStatistics:StatisticalDistribution	rdf:type	owl:Class
dc:contributor	dcterms:description	"Examples of a Contributor include a person, an organization, or a service. Typically, the name of a Contributor should be used to indicate the entity."@en-US
skos:definition	rdfs:label	"definition"@en
bibo:ReferenceSource	rdfs:comment	"A document that presents authoritative reference information, such as a dictionary or encylopedia ."@en

Raw Subject (from FANG_reqts_to_BAE.xlsx)	Predicate	Object
max ambient temperature		
-XX degrees C to +XX degrees C		
level, hard surfaced road		
cross-country		
level, hard surface		
level, clean, clay surface		USCS Soil Classification System
USCS Soil Classification System		
XX mm rainfall per hour		
German dry conditions		NRMM
German wet conditions		NRMM
German snow conditions		NRMM
Jordan dry conditions		NRMM
Jordan sand conditions		NRMM
North Korea dry conditions		NRMM
North Korea wet conditions		NRMM
Root Mean Square (RMS) ride courses		
non-deformable, half-round obstacle of XX inches		
Obstacle Height (in.): WW XX YY ZZ		
all Grade & Slope		
XX% side slope		
slope operations up to and including XX% (T)		
XX% grade		
XX% hard-dry grade		
dry hard surface road that is free of loose material		
slopes up to and including the maximum grade		
dry hard surface, XX% grade (XX degrees)		
Sea State characterized by a XX meter SWH		
calm water		
sea state conditions		
Significant Wave Height (SWH) of XX meters		
river line operations		
XX meter (XX feet) plunging surf		
fresh water		
ambient air temperatures		

temperatures ranging between -XX° F and XX° F		
humid storage conditions		IAW AR 70-38 table 2-1
salt-fog conditions		MCO 4790.18B 16 Jul 04 / TM 4795-34-2 / TM4795-12-1
hard surface road with a coefficient of friction of XX		
distance of XX km		
XX nautical miles of water operation in sea state XX		
stepping up and down a vertical step of XX inches		
a gap no less than XX ft		
a ditch of no less than XX ft deep and no less than XX ft across		
hard surface ingress and egress walls sloped at an angle no less thanXX degrees		
ford a XX" (T)		
fording operations		
flat secondary roads (T)		
max ambient water temperature of XX deg C		
ambient relative humidity of up to XX percent		
-XX ft to +XX ft elevation		
XX inch tree		
lightning strikes		Lightning Indirect Effects environment specified in Paragraph 5.4 of MIL-STD-464A
salt atmosphere		

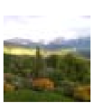
References

1. https://pods.iplantcollaborative.org/wiki/download/attachments/4528119/Geospatial%2BCI.pdf

Labels context

4 Child Pages

- EnvironmentalContextGeospatial
- Semantic Context Architecture
- Semantic Context Language Requirements
- SWEET



EnvironmentalContextGeospatial

4 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 19, 2012 (view change) show comment

Specification

From SWEET, we can use reprSpaceCoordinate.owl or reprSpaceReferenceSystem.owl

UTM	reprSpaceReferenceSystem.owl#UniversalTransverseMe
Cartesian	reprSpaceReferenceSystem.owl#Cartesian"

Local view for "http://sweet.jpl.nasa.gov/2.3/reprSpaceReferenceSystem.owl#Cartesian"

Predicate	Value
rdf:type	reprSpaceReferenceSystem:SpatialReferenceSystem
relaMath:coordinate_1	reprSpaceCoordinate:X
relaMath:coordinate_2	reprSpaceCoordinate:Y
relaMath:coordinate_3	reprSpaceCoordinate:Z

All properties reside in the graph http://sweet.jpl.nasa.gov/2.3/reprSpaceReferenceSystem.owl

This might be enough if we want to use Lat/Lon or UTM to specify the location, and a set of finer coordinate triples to represent lateral and elevation changes.

Other options not a part of SWEET include

- The spatial reference system according to FGDC definition http://www.fgdc.gov/metadata/csdgm/04.html
- Or http://www.w3.org/2003/01/geo/

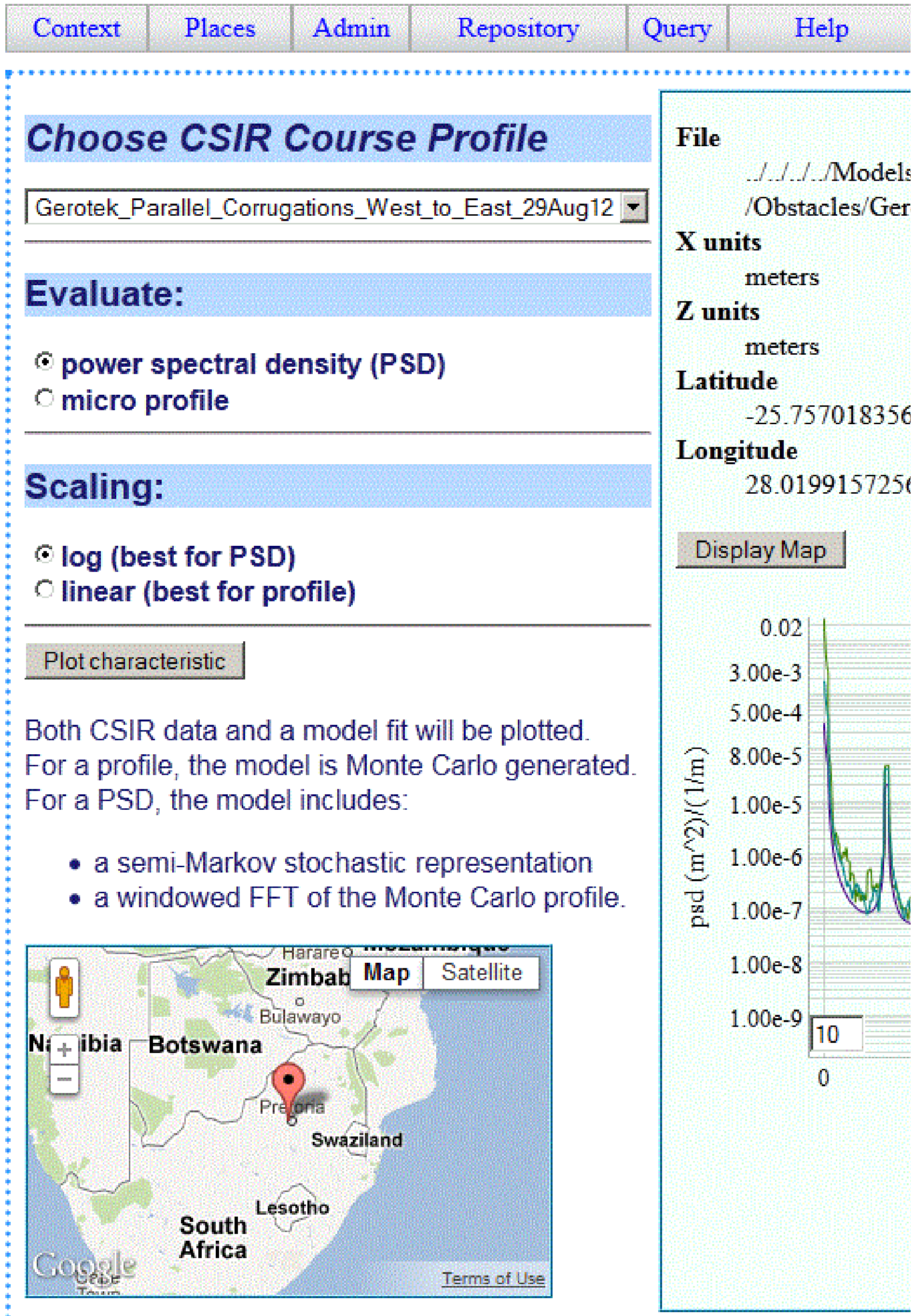
Predicates in graph http://www.w3.org/2003/01/geo/w

Predicate	#Triples	#Distinct subjects	#Distinct objects
rdfs:comment	9	8	9
dc:date	1	wgs84:	"$Date: 2009/04/20 15:00:30 $"
dc:description	1	wgs84:	"A vocabulary for representing latitude, longituc altitude information in the WGS84 geodetic refe datum. Version $Id: wgs84_pos.rdf,v 1.22 2009 15:00:30 timbl Exp $. See http://www.w3.org /2003/01/geo/ for more details."
rdfs:domain	3	3	wgs84:SpatialThing
rdfs:label	8	8	8
rdfs:range	1	wgs84:location	wgs84:SpatialThing
rdfs:subClassOf	1	wgs84:Point	wgs84:SpatialThing
rdfs:subPropertyOf	1	wgs84:location	foaf:based_near
dc:title	1	wgs84:	"WGS84 Geo Positioning: an RDF vocabulary"
rdf:type	7	7	2

Prototype

Using the geospatial coordinates, we can add artifacts, such as a map to the user interface

Geographical Location



Local Coordinates

Context | Places | Admin | Repository | Query | Help

Choose CSIR Course Profile

Gerotek_Parallel_Corrugations_West_to_East_29Aug12

Evaluate:

- (•) **power spectral density (PSD)**
- ( ) **micro profile**

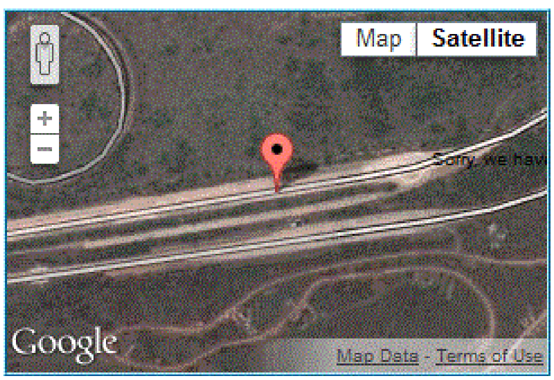
Scaling:

- (•) **log (best for PSD)**
- ( ) **linear (best for profile)**

[Plot characteristic]

Both CSIR data and a model fit will be plotted.
For a profile, the model is Monte Carlo generated.
For a PSD, the model includes:

- a semi-Markov stochastic representation
- a windowed FFT of the Monte Carlo profile.



File
../../../../Models
/Obstacles/Ger

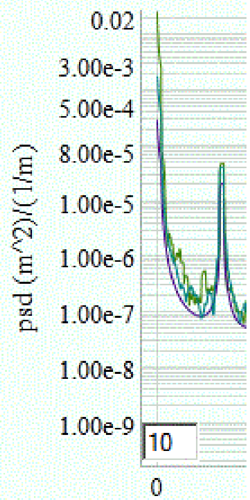
X units
meters

Z units
meters

Latitude
-25.757018356

Longitude
28.019915725

[Display Map]



Detailed View

Context | Places | Admin | Repository | Query | Help

Choose CSIR Course Profile

Gerotek_Parallel_Corrugations_West_to_East_29Aug12

Evaluate:

- (•) power spectral density (PSD)
- ( ) micro profile

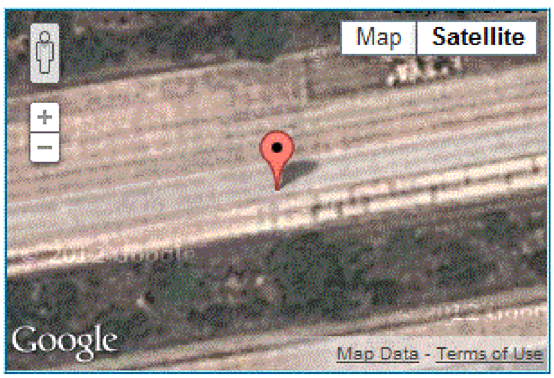
Scaling:

- (•) log (best for PSD)
- ( ) linear (best for profile)

Plot characteristic

Both CSIR data and a model fit will be plotted.
For a profile, the model is Monte Carlo generated.
For a PSD, the model includes:

- a semi-Markov stochastic representation
- a windowed FFT of the Monte Carlo profile.



File
../../../../Model
/Obstacles/Ger

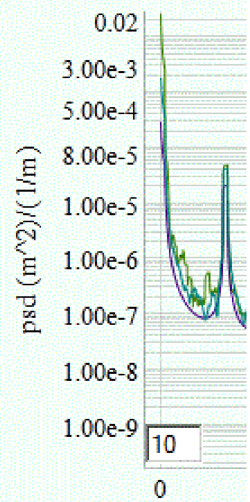
X units
meters

Z units
meters

Latitude
-25.75701835

Longitude
28.01991572

Display Map



Labels context

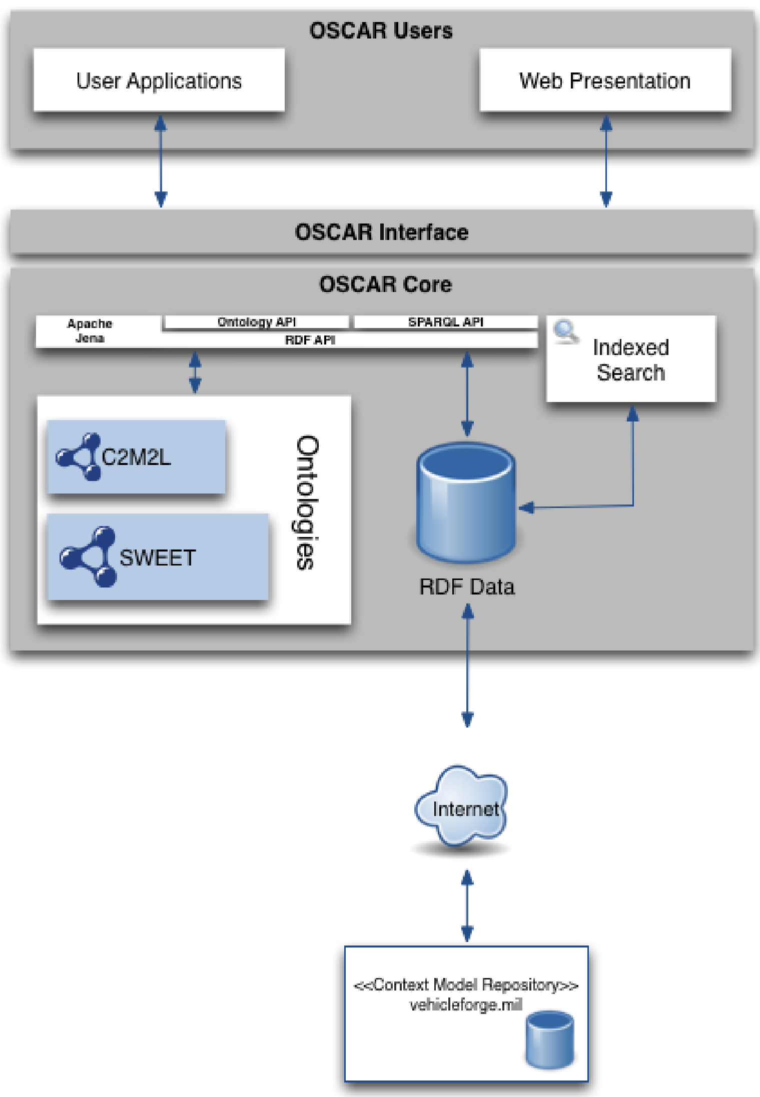
Write a comment...

Semantic Context Architecture

4 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 17, 2012 (view change)

The knowledge-based system we are to implement will provide semantic web discovery capability according to the C2M2L-1 ontology and instance data. OSCAR is short of Ontological System for Context Artifacts and Resources. The goal is to provide guide discovery for users to find context models and associated metadata to enable their simulation. The context models can include collections of PDFs and PSDs.

OSCAR

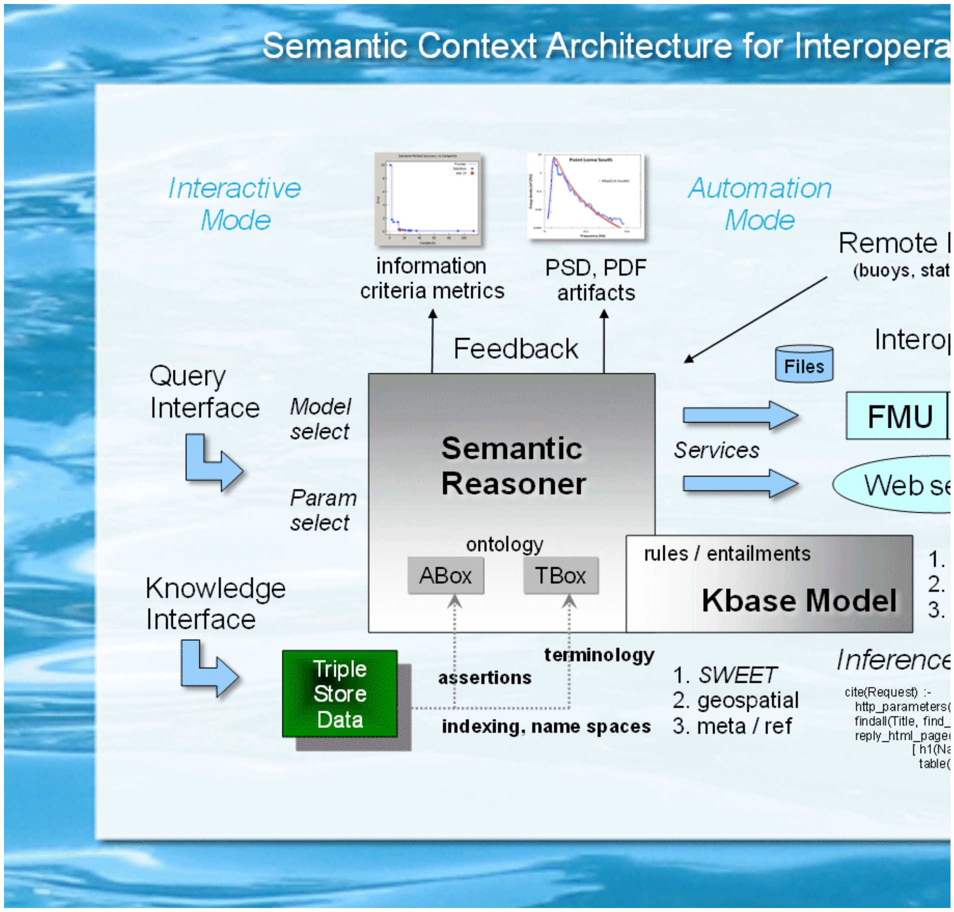


More prototype and design information is here :

SemanticContextArchitectureOscar

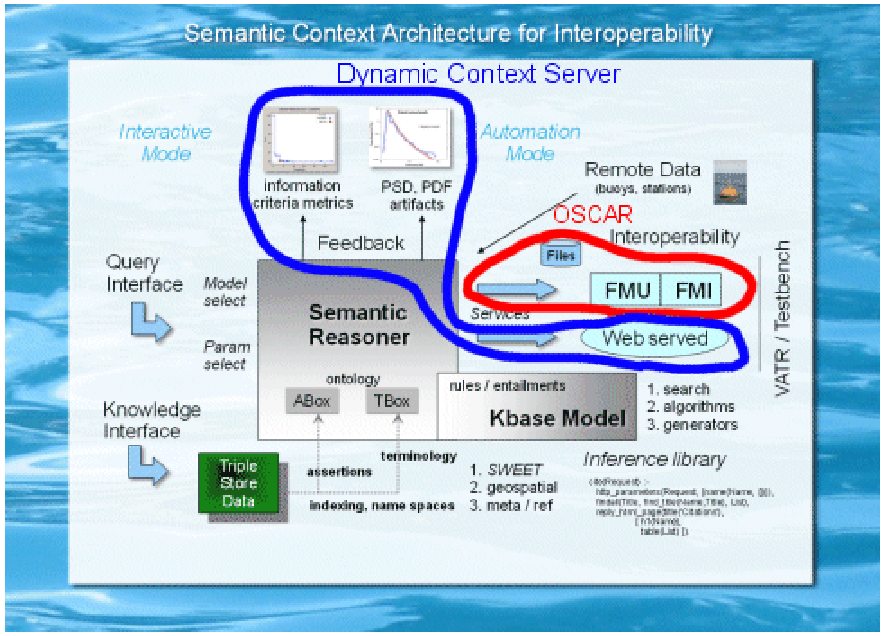
Additional Knowledge Base Capability

To give the user some capability to evaluate and explore the artifacts of the model library, we provide an additional interface that has the capability to serve up artifacts such as PDF and PSD charts, information metrics, and simple visualizations of stochastic and deterministic profiles. This capability is shown running along the top of the following figure. We require a flexible semantic language to support dynamic artifact generation.



Splicing this additional capability into OSCAR is based on conventional web server technology and practices. This allows independent development of the core library mechanisms of OSCAR from the dynamic artifact generation and reasoning capabilities.

The figure below sketches the boundary between the OSCAR (in red) and the supplemental dynamic context (in blue) roles. The triple store ontology is shared along with the semantic web foundation.



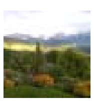
See further on the [Dynamic Context Server]

Labels context

1 Child Page

SemanticContextArchitectureOscar

1 Comment



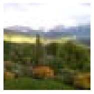
Pukite, Paul R [BAE Systems] Jun 12, 2012

Thomas Huang comments from 6/6/20112 visit

1. - Where will these models be hosted? We started this conversation and thinking vehicleforge.mil could provide the service, but we need information on how to register and retrieve context models from it.
2. - Will these models be deliver directly to the testbed user or will these models be running as a service within the knowledge-based system? There are advantages and disadvantages on both. We can discuss it in the next telecon.
3. - Are these models implemented for certain OS platform like Windows (DLL) or is the project expecting these models to be platform neutral?
4. - There are two kinds of context models - PDFs and PSDs. Each model should be documented for integrator and for validation. I suggest to start putting these models first on paper. A simple template might be
   MODEL <x.y.z>
   a. -- Algorithm: list of formulas and variables and workflow
   b. -- Configuration: list of configurable parameters (e.g seeds, environmental setting)
   c. -- Input: list of input parameters
   d. -- Output: list of output parameters
5. - The knowledge-based system is to also provide cross reference on existing requirements. FANG sent out a list of their requirements. We need to have the complete list and finalize in the near future
6. - You provided a good use case, that is, a search on requirement should yield a list of associated context models. Please provide the mapping between requirements and models.
7. - I am using the two TOPS you provided to guide me on defining the ontology and instance data, but I will need a lot of help from your team on C2M2L-1 concepts and instance data to finalize the design and populate the triplestore.

8. - There service is also to provide properties lookup and constant values lookup. Please provide the list of properties and constants. Simple spreadsheets should be fine. The development team needs this information to drive the backend repository design.
9. - Where will the knowledge-base system be hosted for operation? We started to discuss this, but it needs to be finalized soon. We will setup of development and validation environments consistent to the target operation environment.

Edit □ Remove □ Reply



Write a comment…

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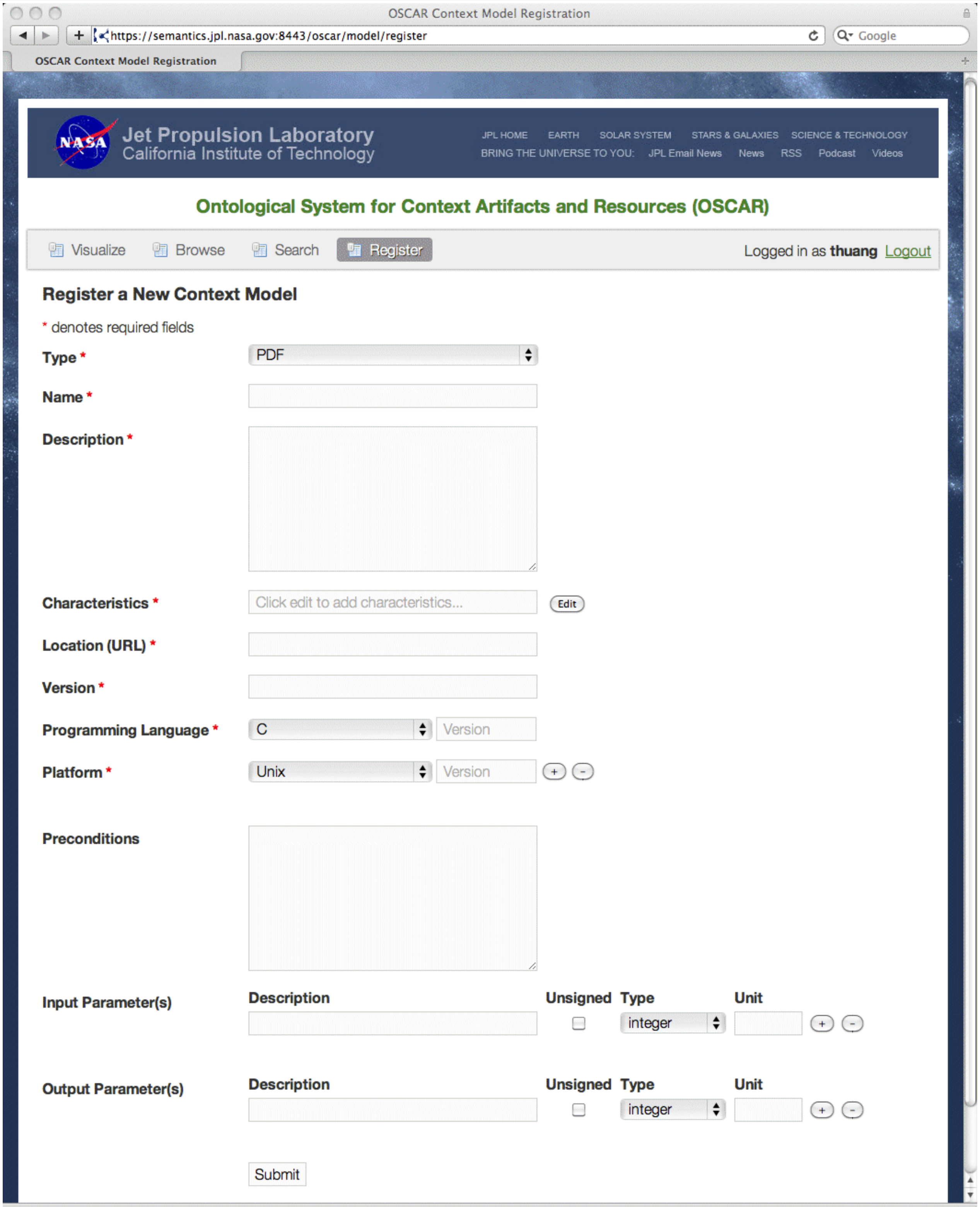
SemanticContextArchitectureOscar

5 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Aug 23, 2012 (view change)

Examples of Oscar model registration used for building the library, and general curation.


OSCAR Context Model Registration
https://semantics.jpl.nasa.gov:8443/oscar/model/register
Google
OSCAR Context Model Registration
Jet Propulsion Laboratory
California Institute of Technology
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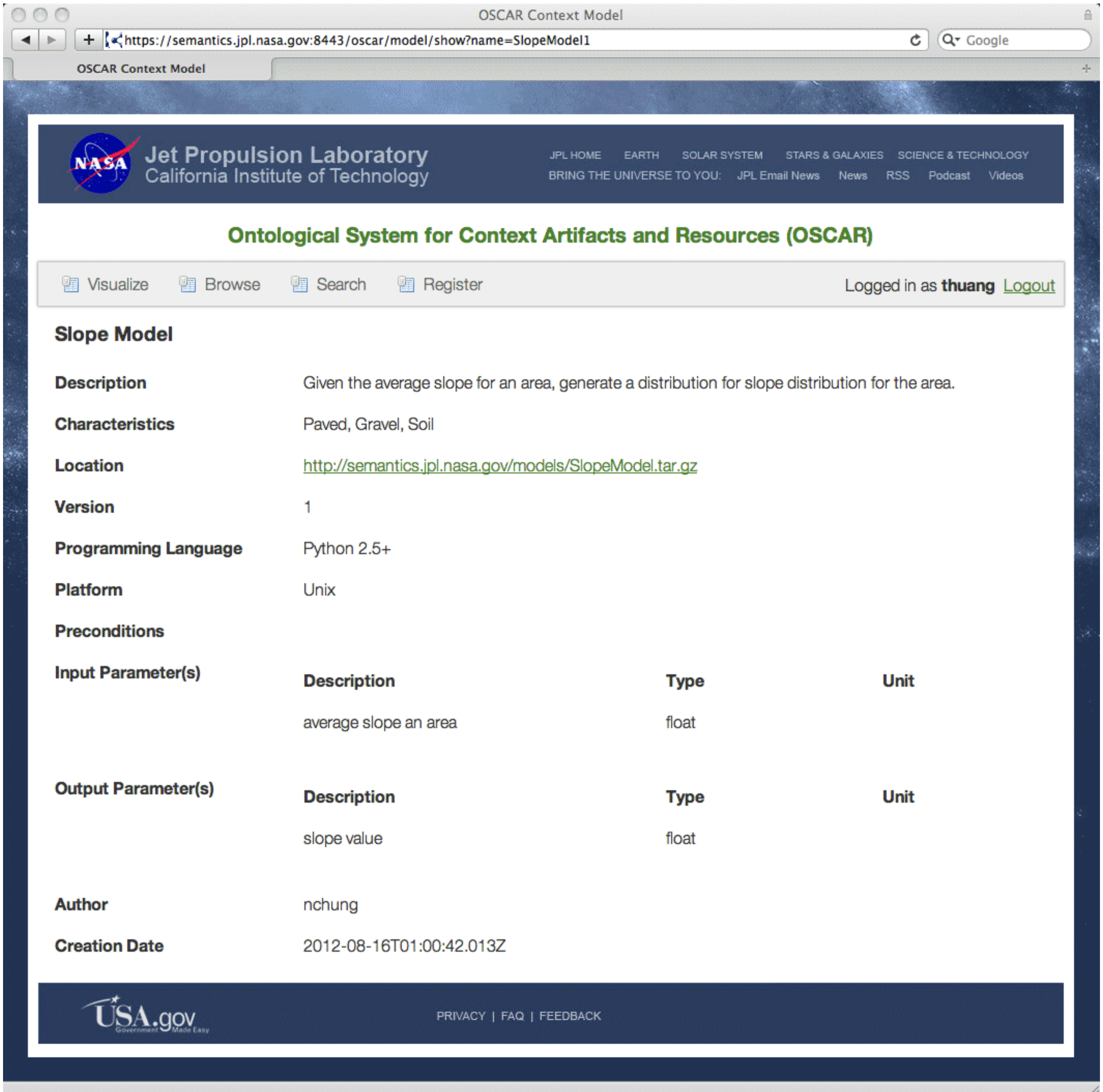
Ontological System for Context Artifacts and Resources (OSCAR)
Visualize Browse Search Register
Logged in as thuang Logout
Register a New Context Model
* denotes required fields
Type *
PDF
Name *
Description *
Characteristics *
Click edit to add characteristics...
Edit
Location (URL) *
Version *
Programming Language *
C
Version
Platform *
Unix
Version
Preconditions
Input Parameter(s)
Description
Unsigned
Type
Unit
integer
Output Parameter(s)
Description
Unsigned
Type
Unit
integer
Submit


OSCAR Context Model

https://semantics.jpl.nasa.gov:8443/oscar/model/show?name=SlopeModel1

Jet Propulsion Laboratory
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Ontological System for Context Artifacts and Resources (OSCAR)

Visualize Browse Search Register Logged in as **thuang** Logout

Slope Model

Description	Given the average slope for an area, generate a distribution for slope distribution for the area.
Characteristics	Paved, Gravel, Soil
Location	http://semantics.jpl.nasa.gov/models/SlopeModel.tar.gz
Version	1
Programming Language	Python 2.5+
Platform	Unix
Preconditions	

Input Parameter(s)

Description	Type	Unit
average slope an area	float	

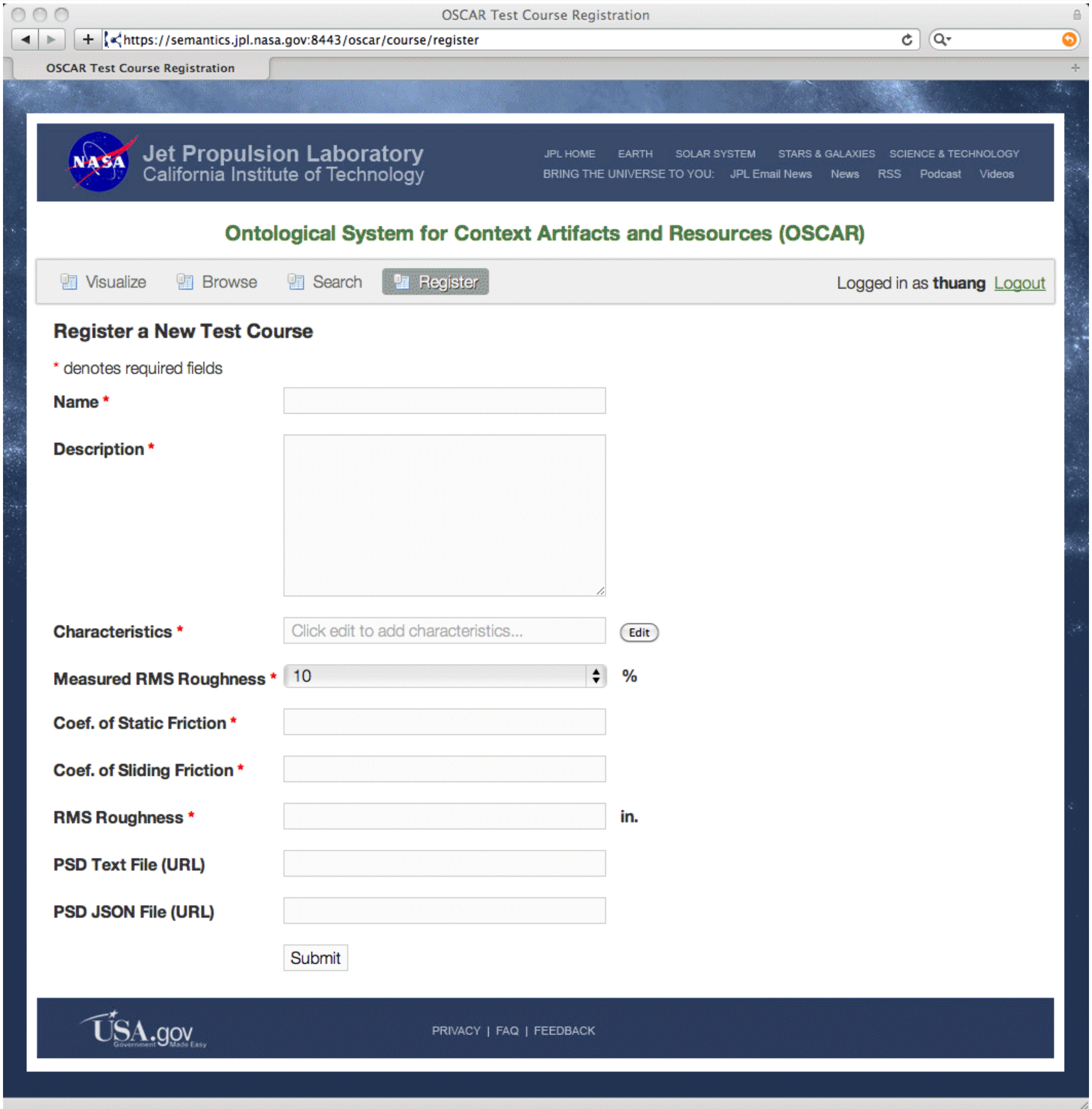
Output Parameter(s)

Description	Type	Unit
slope value	float	

Author	nchung
Creation Date	2012-08-16T01:00:42.013Z

USA.gov

PRIVACY | FAQ | FEEDBACK


OSCAR Test Course Registration
https://semantics.jpl.nasa.gov:8443/oscar/course/register
OSCAR Test Course Registration
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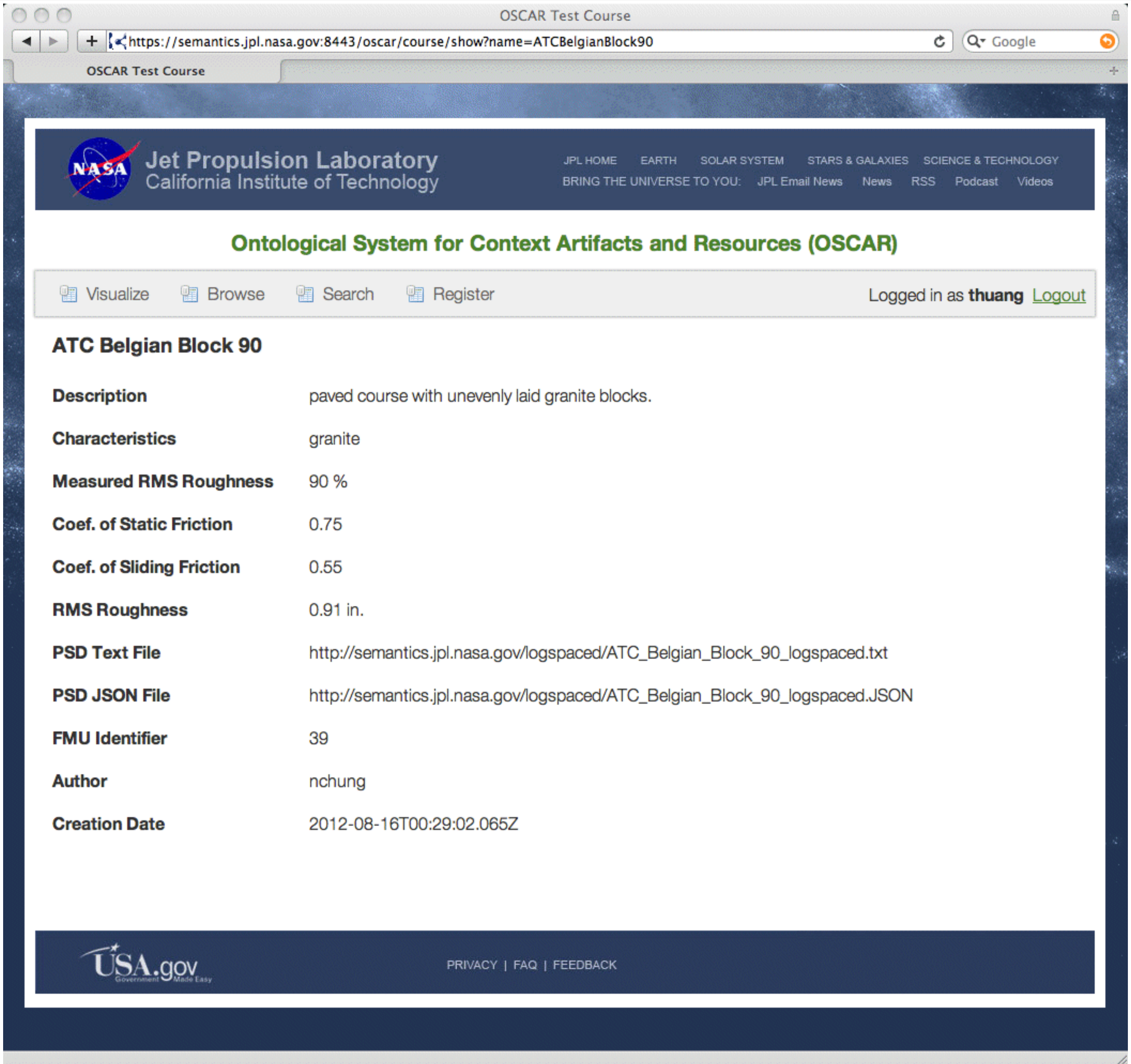
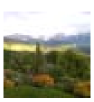
Ontological System for Context Artifacts and Resources (OSCAR)
Visualize Browse Search Register
Logged in as thuang Logout
Register a New Test Course
* denotes required fields
Name *
Description *
Characteristics *
Click edit to add characteristics...
Edit
Measured RMS Roughness *
10
%
Coef. of Static Friction *
Coef. of Sliding Friction *
RMS Roughness *
in.
PSD Text File (URL)
PSD JSON File (URL)
Submit
USA.gov
PRIVACY | FAQ | FEEDBACK



Labels context

1 Comment



Pukite, Paul R [BAE Systems] Aug 23, 2012

Thomas,

I like the way that it is laid out and the comprehensive nature of the inputs.

The additional functionality is to have a guided flow for context-sensitive input parameters. Some of the distributions will have a single parameter, such as a Mean value. For others, such as an accurate sea-state model, it will have a mean and then another parameter describing the non-linearity effects. That is the only complicating factor, so it may need a “guided workflow” input depending on the distribution type context.

So various distributions we may have are:

- Power law – order usually 2, specified by a median value
- Exponential – mean value
- BesselK – mean value
- Rayleigh – mean value
- BesselK_SeaState – mean value plus average depth
- Streched_Exponential – mean value plus stretching parameter

- Normal – mean and variance
- Some other ones such as Weibull will have two parameters and

Some of these distributions derive from other features. For example, the wave height in sea-state actually derives from a BesselK of the energy in the wave. So that knowledge has to be embedded in somehow via a mathematical relation between wave height and energy.

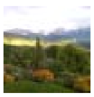
Those could all be terminological data in the triple-store database. The instance data would then draw from the T-box specs.

The other class of input characterizations are the ones dealing with sampling from empirical data, whereby we don’t have a concise stochastic representation. Some of the PSD models will be like this, such as the ones on the Terrain PSD spreadsheet. However not all the PSD models will be like that, in particular the semi-Markov ones that go into the white paper I wrote.

Excellent start, keep chugging.

Paul

Edit · Remove · Reply



Write a comment…

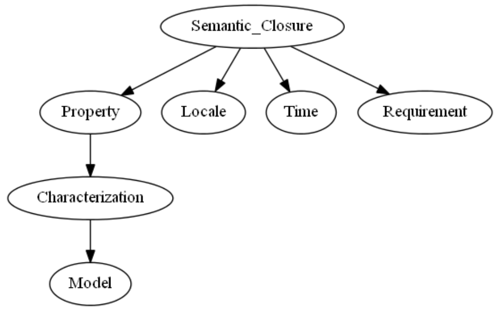
Semantic Context Language Requirements

Edit Share Add Tools

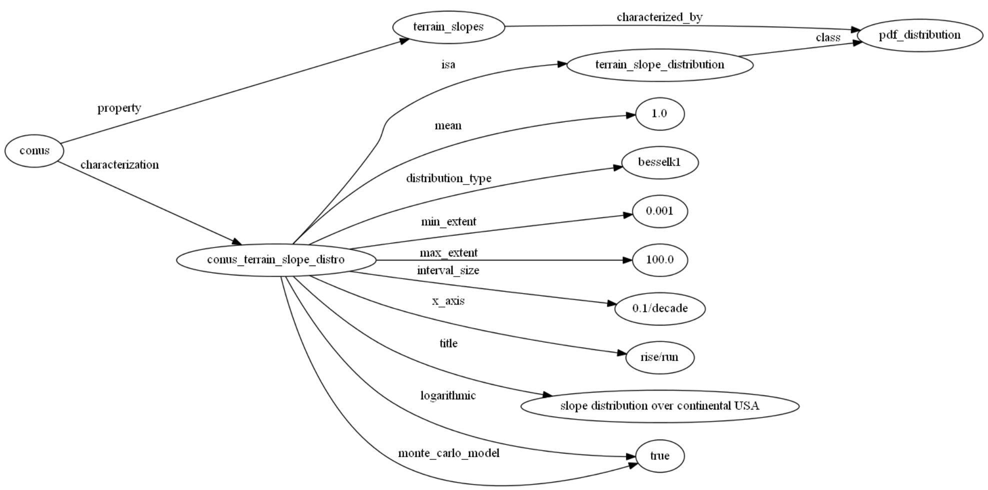
3 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 07, 2012 (view change)

Language Requirements

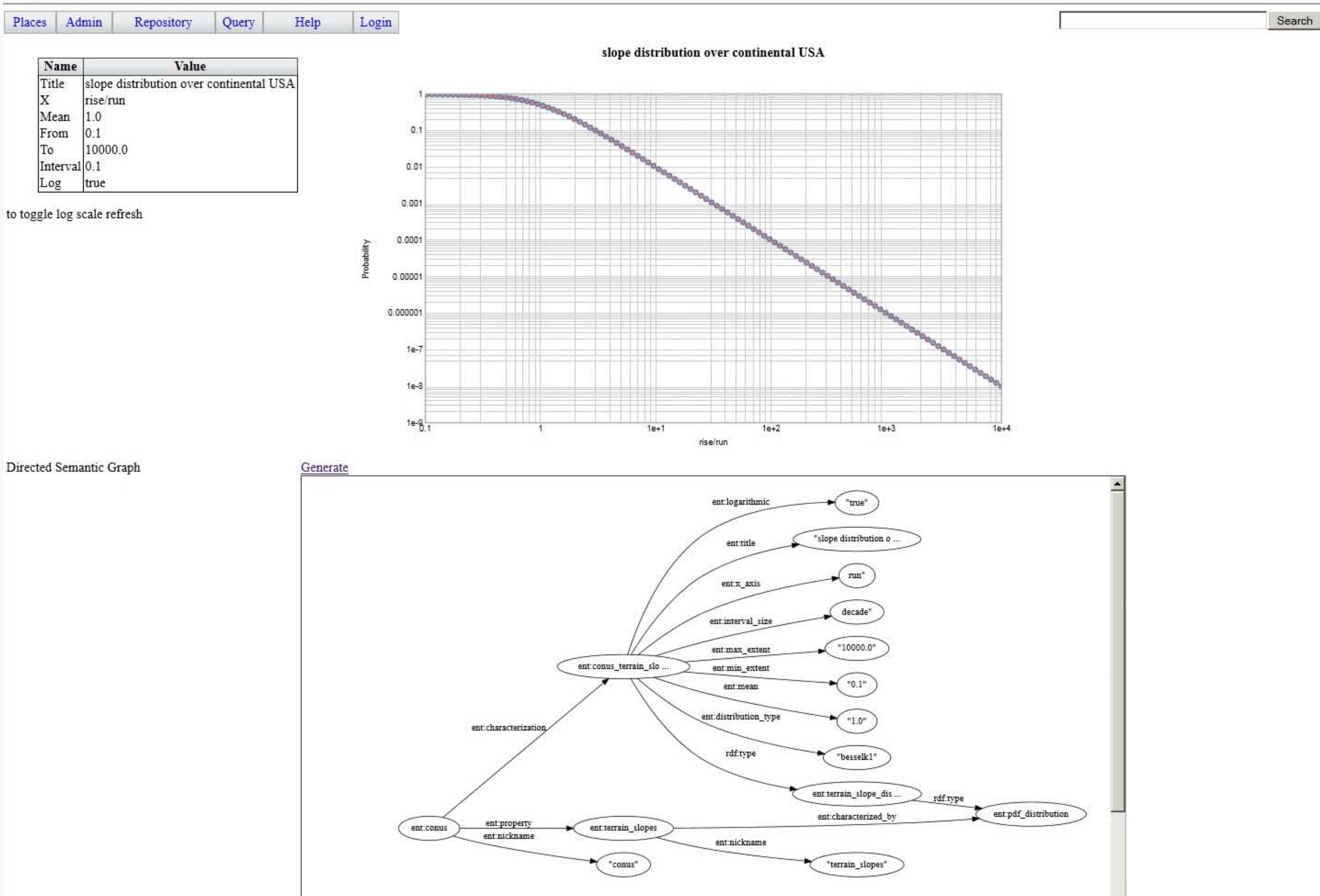
1. Integration with triple-store (RDF, OWL)
2. Integration with statistics framework such as R
3. Knowledge base and logic formulation
4. Search and query
5. XML processing
6. JSON processing
7. Semantic Web servicing – integration of queries as services
8. Ontology graphing
9. Entailment – creating rules that abstractly appear as triple store
10. Generators for code production and data
11. Math and complex math
12. Array and list processing
13. Artifact generation such as graphs for PDF and PSD



Subject/Predicate/Object Closure Graph of a terrain slope PDF for the USA. This gives the logical path of matching up a locale (CONUS) with a feature property (Terrain Slopes) and how to characterize and model that (via probability distribution functions). This was the original closure that was sketched out:



The following screenshot is an example of most of the language requirements pieced together. Two keywords, `locale` and `property`, guide the search to this artifact screen. The `locale` in this example is "conus" which represents the continental USA. The `property` is "terrain_slopes", which indicates the semantic ontology to look up. In this case the linked characterization model is a Probability Density Function (PDF) which contains the information on terrain slope probabilities.



The following table evaluates how many of the language requirements are involved with generating the features in the application above.

Requirement	Feature and Usage
1. Integration with triple-store (RDF, OWL)	All parametric data is stored in RDF and will use OWL and SWEET to specify terminology
2. Integration with statistics framework such as R	Used R to generate the BesselK function
3. Knowledge base and logic formulation	Logical rules were used to guide the user and design the interface and tie to the back-end triple store data
4. Search and query	Used an available search and query framework to integrate
5. XML processing	RDF is an example of XML processing.
6. JSON processing	Integrated into the PDF graphing as the plotting interface requires JSON data format
7. Semantic Web servicing – integration of queries as services	All main web queries are services, extracting the parameters from the input

8. Ontology graphing	The closure of the triple-store data needed for generating a PDF is transferred to a directed graph as shown.
9. Entailment – creating rules that abstractly appear as triple store	Overloaded the triple store to capture the closure trace for the graph.
10. Generators for code production and data	This will get linked to a Monte Carlo generation tool
11. Math and complex math	Part of the language, the complex number math will get used on PSD
12. Array and list processing	Concise list array processing was used to represent and generate the data elements.
13. Artifact generation such as graphs for PDF and PSD	See the above PDF, both linear and log scales are available.

This leads into the features developed for the dynamic context server prototype

Labels None

1 Child Page

SemanticContextArchitectureDynamic

SemanticContextArchitectureDynamic

Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Nov 16, 2012 (view change)

The plan is to provide two views for context modeling services. The view handled by JPL is called Ontological System for Context Artifacts and Resources (OSCAR) and this will register and deliver well-defined models encapsulated as FMU components (and potentially others).

The supplemental view is a dynamic context server (DCS) which provides an environment for handling interactive applications such as guided workflows, artifact viewing, and reusable web services. OSCAR's capabilities will not overlap with the dynamic server's capabilities and in fact the two complement each other. The two views can be integrated through a conventional web-service front-end.

The DCS has been prototyped with a breadth-first view first to make sure that we have all the semantic, ontological, logical, and mathematical capabilities in place.

General Architecture of a Dynamic Context Server

- ### Integration with triple-store semantic data
  - RDF and simple formats such as Turtle used as input files for data and knowledge
  - SWEET provides ontological classification where possible
  - SELECT C FROM {URI} ent:req_category {Text}, {URI} ent:context {C} WHERE Text LIKE "*Auto*"
- ### Knowledge-based logic formulation
  - Rules interact with the triple-store description logic
  - Entailment – creating rules that abstractly appear as triple store
- ### Semantic Web servicing
  - Queries as model services
  - Queries to generate algorithms and code
  - Queries to generate artifacts and metrics
  - http://localhost:3020/servlets/evaluateQuery?repository=default&serialization=rdfxml&queryLanguage=SeRQL&query=SELECT+C+FROM+{URI}+ent%3Areq_category+{Text}%2C+{URI}+ent%3Acontext+{C}+WHERE+Text+LIKE+%22*Auto*%22%0D%0A&resultFormat=html&resourceFormat=plain&entailment=none
- ### Workflows
  - Query-based search and navigation
  - Guided workflow starting from requirements

Architecture Features

- ### Pattern architecture
  - Many context models have similar representation or archetypes
    - e.g. PDF patterns use functional mapping on lists
    - Similar format allows reusable artifacts, such as graphs
  - Models calibrated via parameters for different locales
  - Declarative programming facilitates pattern-matching

- [Installation]()

- ## Graphing of artifacts
  - From models or data
    - PDF and CDF
    - Power Spectral Density
    - Expected value plots
      - Annual, diurnal
      - Growth curves
  - Linear or log scales
  - Noise filtering
  - Inspection of data points
  - Panning and scaling
- ## Domain-specific language for list processing
  - List of X-Y pairs
  - List of X-Y1,Y2,.. n-tuples
  - Math operations on lists
    - Constructors
      - Linear range
      - Log range
  - Dot product
  - Mapping on lists
    - Functions
    - Scaling
  - Convolution
  - Pair Correlation / Auto-correlation
  - Z-difference
  - Integral / Derivative
  - Histogram
  - Direct translation of tuple-lists to graphs
- ## Domain-specific language for complex-number processing
  - Arithmetic
    - Infix operators for multiply, addition, division, power, etc
    - Used for concise semi-Markov terrain profile modeling
  - Built-in FFT for PSD calculation
- ## Integration with general statistical functions
  - R statistics package
    - Uses similar format for mapping against data lists
    - i.e. Statistical operators act on the entire list
  - Provides access to less common functions such as Bessel
- ## Random number generation
  - PDF generators for
    - Uniform
    - Exponential
    - Bessel
    - Rayleigh
    - Fat-tail
  - Profile generators
    - Random walk based
      - Markov
      - Semi-markov
    - Superposition of sines
- ## Reference and citation knowledge capture
  - Integration with Zotero citation management system
    - SWEET keyword categorization
    - Generation of RDF stores
- ## Rules for searching and presenting knowledge
  - Based on ontological terms
  - General content search

    - Custom input and output data processing
        - XML and HTML
        - JSON
        - CSV
- Diagramming
    - AT&T Graphviz compatibility with SVG
    - Closure of rules as a directed graph.
    - Hierarchy and cloud diagrams
- Generators for code production and data
    - Tabulation of data, i.e. connectors for spreadsheet
    - Symbolic representations of algorithms
        - Used for on-line calculation
        - Translated to C-code, Python, etc
- GUI development
    - Uses definite clause grammars (DCG) to generate valid HTML
    - Declarative style of programming, similar but much more concise and powerful than XSLT
- Portability
    - Windows
    - Linux
    - Cloud environment
- Maintenance of library
    - Browsing
    - Site roadmap
    - Documentation
    - Statistical usage
    - Password control for administration of repository

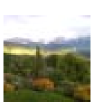
Physical Domains

- List of physical domains
    - Land
    - Atmosphere
    - Aquatic
- Deterministic and stochastic representations
    - Stochastic terrains characterized by PSD's
    - Deterministic obstacles

Installation

SemanticContextWeb

Labels None



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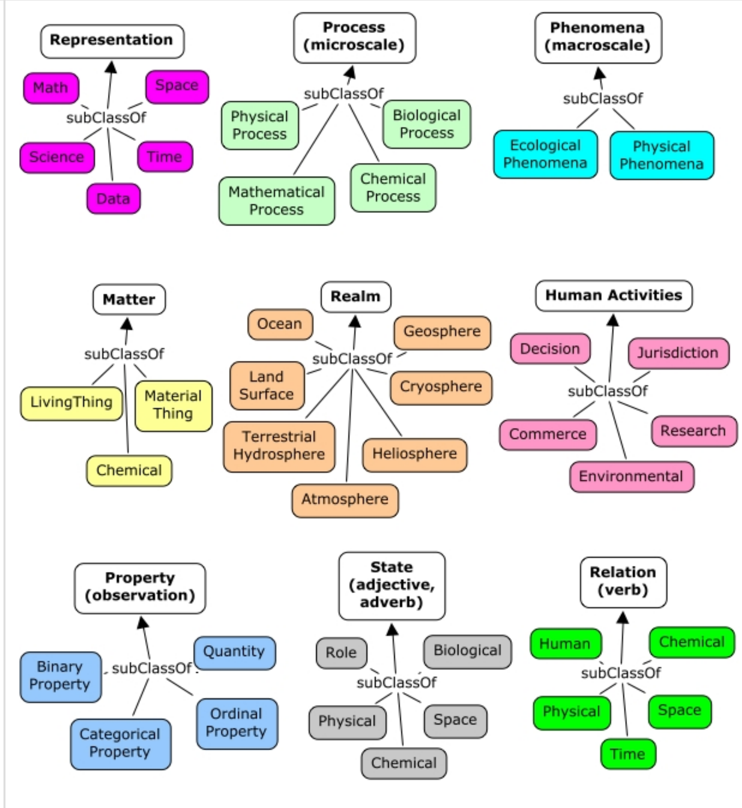
SWEET

Edit Share Add Tools

Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Jun 21, 2012 (view change)

Semantic Web for Earth and Environmental Terminology (SWEET)

Official Site : http://sweet.jpl.nasa.gov/



Usage

Start by loading sweetAll into ontology.

http://sweet.jpl.nasa.gov/2.3/sweetAll.owl

Then it is a matter of following the owl:imports to recursively import the various SWEET domains.

SWEET depends on the following namespaces:
http://www.w3.org/2002/07/owl#
http://www.w3.org/1999/02/22-rdf-syntax-ns#
http://www.w3.org/2000/01/rdf-schema#
http://www.w3.org/2001/XMLSchema#

Namespace prefixes

We want to use shortened prefixes to refer to the SWEET terminology

e.g. `wind` for http://sweet.jpl.nasa.gov/2.3/phenAtmoWind.owl

prefix	SWEET
wind	http://sweet.jpl.nasa.gov/2.3/phenAtmoWind.owl

land	http://sweet.jpl.nasa.gov/2.3/realmLandform.owl
scimodel	http://sweet.jpl.nasa.gov/2.3/reprSciModel.owl
res	http://sweet.jpl.nasa.gov/2.3/humanResearch.owl
wave	http://sweet.jpl.nasa.gov/2.3/phenWave.owl
precip	http://sweet.jpl.nasa.gov/2.3/phenAtmoPrecipitation.owl
pollutant	http://sweet.jpl.nasa.gov/2.3/phenAtmoTransport.owl
chemprop	http://sweet.jpl.nasa.gov/2.3/propChemical.owl
chemproc	http://sweet.jpl.nasa.gov/2.3/procChemical.owl
energy	http://sweet.jpl.nasa.gov/2.3/propEnergyFlux.owl
coastal	http://sweet.jpl.nasa.gov/2.3/realmLandCoastal.owl
fluid	http://sweet.jpl.nasa.gov/2.3/phenFluidTransport.owl
emi	http://sweet.jpl.nasa.gov/2.3/phenElecMag.owl
bio	http://sweet.jpl.nasa.gov/2.3/phenBiol.owl
phys	http://sweet.jpl.nasa.gov/2.3/relaPhysical.owl
knowl	http://sweet.jpl.nasa.gov/2.3/humanKnowledgeDomain.owl
systemstate	http://sweet.jpl.nasa.gov/2.3/stateSystem.owl
repr	http://sweet.jpl.nasa.gov/2.3/repr.owl
units	http://sweet.jpl.nasa.gov/2.3/reprSciUnits.owl
prov	http://sweet.jpl.nasa.gov/2.3/reprSciProvenance.owl
method	http://sweet.jpl.nasa.gov/2.3/reprSciMethodology.owl
component	http://sweet.jpl.nasa.gov/2.3/reprSciComponent.owl
ocean	http://sweet.jpl.nasa.gov/2.3/realmOcean.owl
solid	http://sweet.jpl.nasa.gov/2.3/phenSolid.owl
sci	http://sweet.jpl.nasa.gov/2.3/relaSci.owl
state	http://sweet.jpl.nasa.gov/2.3/statePhysical.owl
distance	http://sweet.jpl.nasa.gov/2.3/propSpaceDistance.owl
time	
massprop	http://sweet.jpl.nasa.gov/2.3/propMass.owl
soil	http://sweet.jpl.nasa.gov/2.3/realmSoil.owl
hydro	
speed	http://sweet.jpl.nasa.gov/2.3/propSpeed.owl
ratio	http://sweet.jpl.nasa.gov/2.3/propDimensionlessRatio.owl
quant	http://sweet.jpl.nasa.gov/2.3/propQuantity.owl
datum	http://sweet.jpl.nasa.gov/2.3/reprDataModel.owl
coord	http://sweet.jpl.nasa.gov/2.3/reprSpaceCoordinate.owl
scale	http://sweet.jpl.nasa.gov/2.3/stateSpaceScale.owl
tod	http://sweet.jpl.nasa.gov/2.3/reprTimeDay.owl
format	http://sweet.jpl.nasa.gov/2.3/reprDataFormat.owl

loc	http://sweet.jpl.nasa.gov/2.3/propSpaceLocation.owl
noise	http://sweet.jpl.nasa.gov/2.3/phenWaveNoise.owl
service	
lightning	http://sweet.jpl.nasa.gov/2.3/phenAtmoLightning.owl
thermo	http://sweet.jpl.nasa.gov/2.3/stateThermodynamic.owl
vis	http://sweet.jpl.nasa.gov/2.3/stateVisibility.owl
impact	http://sweet.jpl.nasa.gov/2.3/stateRoleImpact.owl
stats	http://sweet.jpl.nasa.gov/2.3/reprMathStatistics.owl
diffusion	http://sweet.jpl.nasa.gov/2.3/propDiffusivity.owl
freq	
realm	http://sweet.jpl.nasa.gov/2.3/stateRealm.owl
cloud	http://sweet.jpl.nasa.gov/2.3/phenAtmoCloud.owl
particle	http://sweet.jpl.nasa.gov/2.3/matrParticle.owl

Some of these are spread out into phenomena, properties, process, realm so we want to retain those concepts.

The following table lays out the namespace organization as 9 top-level concept ontologies. Certain terms, such as "Chemical" have multiple conceptual meanings; in this case Chemical has meanings in the Process, Property, Relational, and State concepts. So this corresponds to the namespace identifiers procChemical, propChemical, relaChemical, and stateChemical. The table is organized sparsely to get a feel for how terminology spans the various concept namespaces. Highlighted terms span columns. Cells that we won't use will eventually get deleted to reduce complexity.

human (Human Activities)	matr (Matter)	phen (Phenomenon) macroscale	proc (Process) microscale	prop (Property) observation	realm	(
~~Agriculture~~	*Aerosol*	***Atmo***		*Binary*	***Atmo***	
~~Commerce~~	~~Animal~~	*AtmoCloud*		*Capacity*	~~AtmoBoundaryLayer~~	
Decision		*AtmoFog*		*Categorical*	*AtmoWeather*	
		~~AtmoFront~~		*Charge*		
		AtmoLightning	***Chemical***	***Chemical***		***C***
		AtmoPrecipitation		*Conductivity*		
		AtmoPressure		*Count*		
		~~AtmoTransport~~		*Difference*		
		AtmoWind		*Diffusivity*		
		AtmoWindMesoscale		*DimensionlessRatio*		
	~~Biomass~~	~~Biol~~			*BiolBiome*	
	Element	~~Cryo~~			***ClimateZone***	***C***
	ElementalMolecule	*Cycle*			*Cryo*	*H*

		CycleMaterial			EarthReference	
		~~Ecology~~				***M***
		ElecMag				
	~~Energy~~	***Energy***		***Energy***		
~~EnvirAssessment~~	*Equipment*	~~EnvirImpact~~		***EnergyFlux***		
~~EnvirConservation~~	~~Facility~~	*FluidDynamics*		*Fraction*		
~~EnvirControl~~	~~Industrial~~	***FluidInstability***		*Function*		
~~EnvirStandards~~	*Instrument*	*FluidTransport*		*Index*		
~~Jurisdiction~~	*Ion*	~~Geol~~		*Mass*	~~Geol~~	
KnowledgeDomain	~~Isotope~~	~~GeolFault~~		~~MassFlux~~	~~GeolBasin~~	
Research	~~Microbiota~~	~~GeolGeomorphology~~		***Ordinal***	~~GeolConstituent~~	
TechReadiness	~~Mineral~~	~~GeolSeismicity~~		*Pressure*	*GeolContinental*	
~~Transportation~~	~~NaturalResource~~	~~GeolTectonic~~		*Quantity*	~~GeolOrogen~~	
	~~OrganicCompound~~	*GeolVolcano*				
	~~Particle~~[atomic]	~~Helio~~	***Physical***			F
	Plant	***Hydro***		~~Rotation~~	***Hydro***	
	Rock	*Mixing*	*StateChange*		*HydroBody*	*F*
	~~RockIgneous~~				*LandAeolian*	
	Sediment				*LandCoastal*	***S***
	Water				*LandFluvial*	
					Landform	
					LandGlacial	
					LandOrographic	
					~~LandProtected~~	
					~~LandTectonic~~	
					~~LandVolcanic~~	
		Ocean			***Ocean***	
		OceanCoastal			~~OceanFeature~~[names]	
		~~OceanDynamics~~			~~OceanFloor~~[reef]	
		PlanetClimate			*Region*	
		~~Reaction~~			*Soil*	
		Solid				
		~~Star~~		***Space***		***S***
				SpaceDirection		
				SpaceDistance		
				SpaceHeight		
				SpaceLocation		

				SpaceMultidimensional		
		System		*SpaceThickness*		
		SystemComplexity		*Speed*		
		Wave	***Wave***	*Temperature*		
		WaveNoise		*TemperatureGradient*		
				Time		***T***
				TimeFrequency		

Examples

humanDecision	Objective	realm	Land
humanKnowledgeDomain	Rheology	realmAtmo	Troposphere
humanResearch	Publication	realmAtmoWeather	CloudBase
humanTechReadiness	TRL	realmBiolBiome	Grassland, Terrain
		realmClimateZone	MarineClimate
		realmCryo	AlpineTundra
matr	Medium	realmHydro	SurfaceWater
matrAerosol	Particulate	realmHydroBody	Lake
matrElement	Iron	realmLandAeolian	SandDune
matrElementalMolecule	O2	realmLandCoastal	Shoreline
matrEquipment	Vehicle	realmLandFluvial	Wash
matrInstrument	Buoy	realmLandform	Land
matrPlant	Tree	realmLandGlacial	Esker
matrRock	SedimentaryRock	realmLandOrographic	Hill
matrSediment	Sand	realmOcean	OpenOcean
matrWater	SeaWater	realmRegion	Polar
		realmSoil	Ground
phen	StochasticProcess		
phenAtmo	Sunlight	rela	hasRealm
phenAtmoCloud	Cloud	relaChemical	hasMedium
phenAtmoFog	SaltHaze	relaClimate	hasAverageAnnualTemp
phenAtmoLightning	Lightning	relaHuman	produces
phenAtmoPrecipitation	Rainfall	relaMath	hasScale
phenAtmoPressure	Barometric	relaPhysical	hasSpectralBand

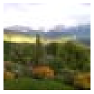
phenAtmoTransport	AcidFog	relaProvenance	hasInferenceRule
phenAtmoWind	SandStorm	relaSci	hasMagnitude
phenAtmoWindMesoscale	CanyonWind	relaSpace	hasSpatialScale
phenCycle	DiurnalCycle	relaTime	halfLife
phenElecMag	ElectricField		
phenEnergy	WindEnergy		
phenFluidDynamics	Eddy	repr	LogarithmicScale
phenFluidInstability	Wake	reprDataFormat	ASCII
phenFluidTransport	Buoyancy	reprDataModel	DataStructure
phenGeolVolcano	VolcanicPlume	reprDataProduct	Curate
phenHydro	Streamflow	reprDataService	FormatConversion
phenMixing	FickianDiffusion	reprDataServiceAnalysis	FourierTransform, SpectralAnalysis
phenOcean	OceanPhenomena	reprDataServiceGeospatial	Map
phenOceanCoastal	BreakingWave	reprDataServiceReduction	Normalize
phenPlanetClimate	LocalClimate	reprDataServiceValidation	Calibrate
phenSolid	Ablation	reprMath	Equation
phenSystem	Growth	reprMathFunction	ProbabilityDensityFuncti
phenSystemComplexity	Pattern	reprMathFunctionOrthogonal	Harmonic
phenWave	ShallowWaterWave	reprMathGraph	Digraph
phenWaveNoise	WhiteNoise	reprMathOperation	Slope
		reprMathSolution	Simulation
		reprMathStatistics	Statisticalsample
proc	Force	reprSciComponent	Input
procChemical	Corrosion	reprSciFunction	Invariant
procPhysical	Cooling	reprSciLaw	EmpiricalLaw
procStateChange	Freezing	reprSciMethodology	RemoteSensing
procWave	RayleighScattering	reprSciModel	Spectral
		reprSciProvenance	Workflow
		reprSciUnits	hertz
prop	Precision	reprSpace	Space
propBinary	BinaryProperty	reprSpaceCoordinate	Pitch
propCapacity	HeatCapacity	reprSpaceDirection	Uphill
propCategorical	StandardIndustrialClassification	reprSpaceGeometry	Point
propCharge	ElectricFieldStrength	reprSpaceGeometry3D	Dome
propChemical	pH	reprSpaceReferenceSystem	UniversalTransverseMe
propConductivity	ThermalConductivity	reprTime	UniversalTime
propCount	NumberDensity	reprTimeDay	Sunrise
propDifference	Deviation	reprTimeSeason	Winter

propDiffusivity	ThermalDiffusivity		
propDimensionlessRatio	DragCoefficient		
propEnergy	Entropy	state	BinaryState
propEnergyFlux	Insolation	stateChemical	Acid
propFraction	Correlation	stateDataProcessing	Scaled
propFunction	StandardDeviation	stateFluid	Buoyant
propIndex	Turbidity	stateOrdinal	Medium
propMass	Density	statePhysical	WaveState
propOrdinal	SpectralBand	stateRealm	Aquatic
propPressure	BarometricPressure	stateRole	Provider
propQuantity	PhysicalConstant	stateRoleChemical	Oxidizer
propSpace	Curvature	stateRoleGeographic	Highway
propSpaceDirection	Angle	stateRoleImpact	Rough
propSpaceDistance	Wavelength	stateRoleRepresentative	Sample
propSpaceHeight	Topography	stateRoleTrust	Unknown
propSpaceLocation	Position	stateSolid	Rigid
propSpaceMultidimensional	Area	stateSpace	Point
propSpaceThickness	Precipitation	stateSpaceConfiguration	Ridged
propSpeed	WindSpeed	stateSpaceScale	Continental
propTemperature	DewPoint	stateSpectralBand	RadioWave
propTemperatureGradient	ThermalGradient	stateStorm	WindScale
propTime	Latency	stateSystem	Stochastic
propTimeFrequency	Rate	stateThermodynamic	MaximumEntropy
		stateTime	1hour
		stateTimeFrequency	Diurnal
		stateVisibility	Cloudy

List of possible terms for SWEET

- sea wave / wind wave (choppy waves caused by wind)
- prop:Fideltiy spelled wrong
- stateRoleBiological:Poision spelling
- Bessel function (math function)
- convolution (math operation)
- ambient temperature (temperature, reprSciComponent:Ambient?)
- requirement (alias for humanDecision:Objective)
- slope/grade for terrain (alias for reprSpaceCoordinate:pitch ? or reprMathOperation:Slope)
- moguls (terrain)

Labels context



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Environmental Context Requirements

2 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Jun 29, 2012

The context model applied to a simulation typically derives from a requirements or text document

The ontology should allow the description of the path from a source (requirements) to a target (model)

Possibilities of describing the source text include:

1. Short phrases indicating the environmental context,
   such as ***"level, hard-surface road"***
   - Linked to a document they appear in.
   - Defined in some other reference, possibly a standard.
   - Target models and documents are easily linked to phrases via semantic descriptions
2. Description of specific vehicle requirements or tests,
   such as ***"6 watt absorbed power"***
   - Linked to a document that contains the complete description.
   - All target models applicable are linked to the named requirement
3. Long description of the requirement
   - Same as 2 but description maintained in knowledge base
4. Requirements for passing specific tests,
   such as ***"Churchville A course"***
   - Specific target models applicable to the test are linked to the test case.

The generality is highest at #1 and least in #4.

The chart below shows a concordance between a short-phrase requirement, a link to the source it was derived from, and then a step in the workflow path. If the phrase has further meaning, it can also be linked to another document.

> *from : " The vehicle shall be capable of being placed outdoor in long term storage, up to XX months, at temperatures ranging between -XX° F and XX ° F (-XX° C to XX° C) , in **humid storage conditions** IAW **AR 70-38 table 2-1** and in salt-fog conditions per MCO 4790.18B 16 Jul 04 / TM 4795-34-2 / TM4795-12-1 without degradation. "*

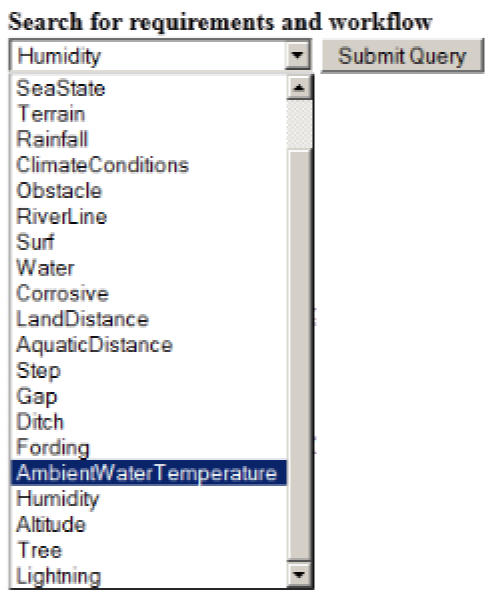
The phrase "humid storage conditions" is pulled from the text and linked to a specific model as one triple. The same phrase is also registered as an "in accordance with" to a specific Army Regulation standard "AR 70-38" and at a specific location "table 2-1".

https://babelfish.arc.nasa.gov/confluence/display/AVMPROJ/BAE#

Humidity

requirement	source	workflow path
ambient relative humidity of up to XX percent	doc	model_index
humid storage conditions	doc	model_index
humid storage conditions	AR-70-38	table 2.1

The procedure then follows to parse the text for the rest of the phrases, and add each to the semantic knowledge base, using the SWEET ontology to categorize the environmental contexts. The user can then browse through the categories to establish the workflow.

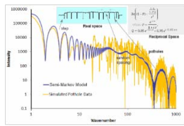


Fine Terrain Features

Edit Share Add Tools

6 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 24, 2012 (view change)

Data Sources

- OpenCRG
  Mercedes-Benz test track data and data translation code : http://www.vires.com/opencrg/download.htm
- CSIR C2M2L partner
  Pothole examples attached: (1) OpenCRG format, (2) Matlab format zipped
  
- TOPS
  Open military test course data

Power Spectral Densities of Terrain

Models

Two approaches to generating terrain profiles based on power spectral densities (PSD)

1. Superposition of randomly phased sine waves to accomplish a pseudo inverse Fourier transform of the PSD
2. Fitting a semi-Markov autocorrelation model of random walk to the PSD (via the Weiner-Khinchin theorem), see Terrain Spectroscopy

Each approach has benefits and drawbacks

Benefits

- The superposition approach is fast and automatic as it works as a rough heuristic
- The semi-Markov autocorrelation function approach is based on stochastic properties of the terrain so can model phase and skew

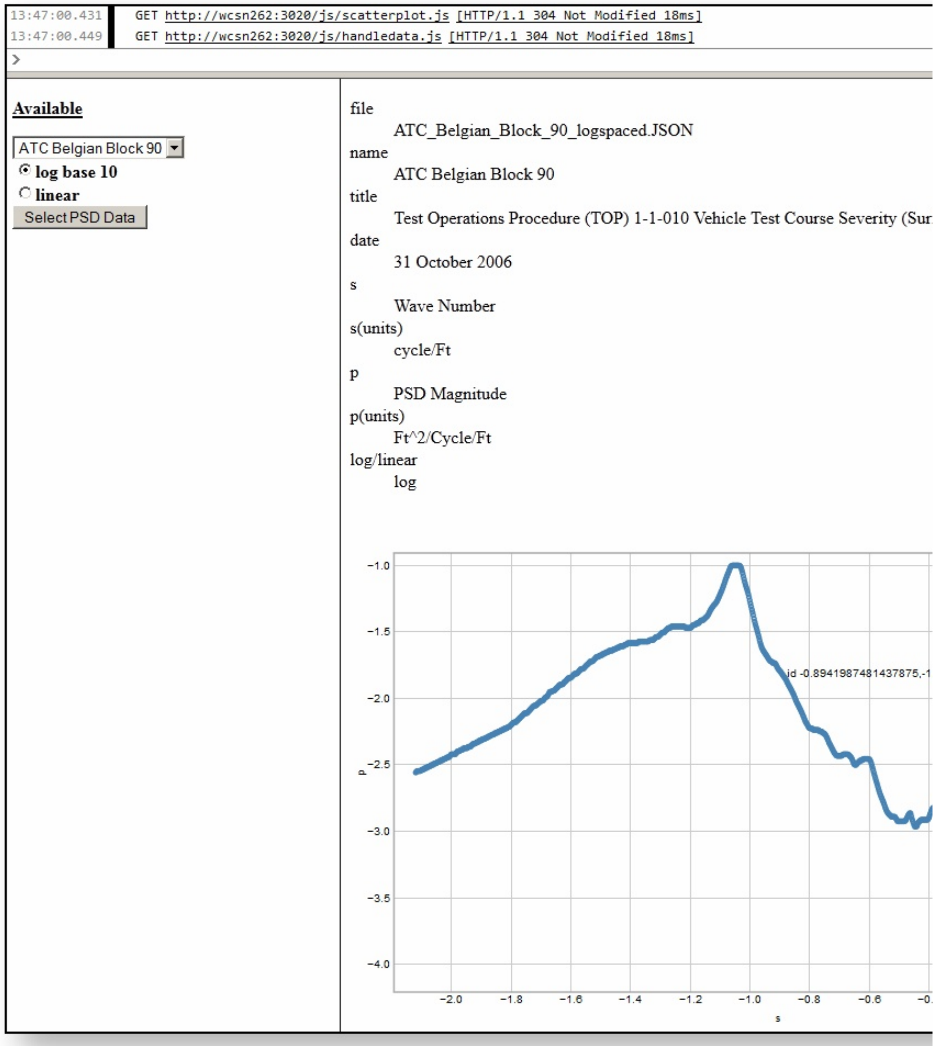
Drawbacks

- The superposition approach will show a repeat sequence based on the lowest spatial frequency and needs to approximate phase (no asymmetries possible)
- The semi-Markov autocorrelation function approach requires a fitting process, and gets the most benefit from prior knowledge in addition to that provided by the PSD. However, once the models are created, new models can easily be composed from the old ones.

The terrain profile context models will include both variants.

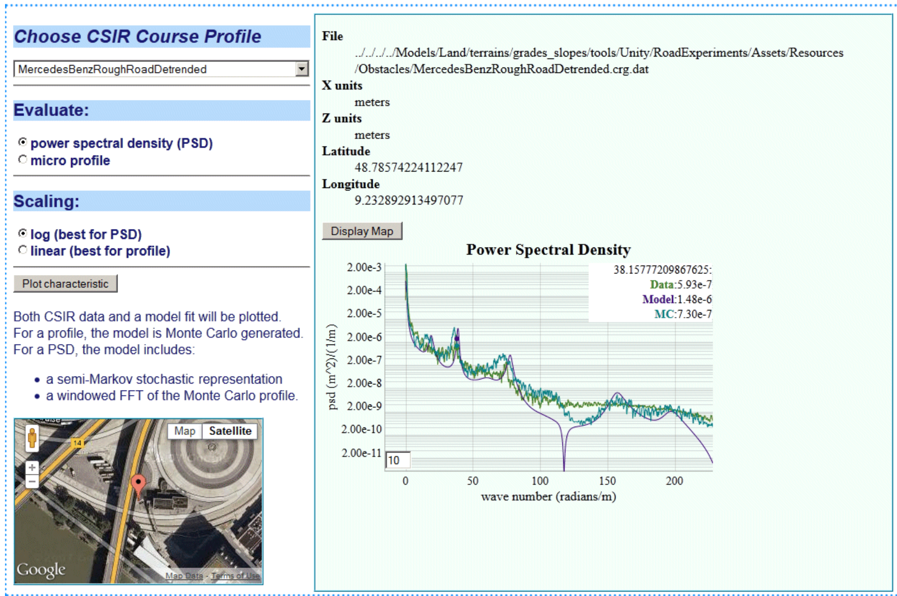
Data

The figure below shows a prototype of a semantic web indexing renderer. This will index against an ontologically categorized set of terrain PSD data cataloged from Test Operating Procedures (TOPS). The data file will contain header information necessary to calibrate the scales.



We now have data from CSIR and a few examples are shown in ContextModelsCSIR.

One example that CSIR provided is a Belgian Block track. As a benefit to the detailed analysis that went into fitting to a semi-Markov moded, we can use the same model fit to the CSIR Belgian Block course to fit to Mercedes Benz test track data. From a OpenCRG data file called "RoughRoad", the following model reused the exact dimensions and weighting of the CSIR fit.



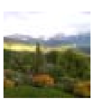
Python Terrain Generator

Python version of the core from Roger Polston's terrain generator (based on approach 1 above). It takes a JSON file containing PSD terrain data, and generates vertical offset data using the specified step size and distance. Get it here: terrain_gen.py .

Labels context

2 Child Pages

- OpenCRG
- TOPS



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OpenCRG

Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Jun 28, 2012 (view change)

OpenCRG Home Page

OpenCRG recommendations

email 4/1/2012

After doing some prototyping with the OpenCRG format that you suggested, we find that it is very acceptable for processing. It has very good resolution and it appears very efficient in memory and speed.

For the format of raw terrain data we propose the following specification.

Specification

		Description
Source	OpenCRG (http://www.opencrg.org/	Fixed (non-deforming) terrain format
Input	File name	
Input	U (meters)	Distance along the path
Input	V (meters)	Distance perpendicular to the path
Output	Z (meters)	Elevation at (U,V) point along path
Output	UTM	Location of starting point of path

Table 1: Path based interface

		Description
Source	OpenCRG (http://www.opencrg.org/	Fixed (non-deforming) terrain format
Input	File name	
Input	X (meters)	Distance Easting in grid
Input	Y (meters)	Distance Northing in grid
Output	Z (meters)	Elevation at (X,Y) point in grid
Output	UTM	Location of lower left corner of grid

Table 2: Grid based interface

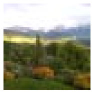
Notes:

A combination of path and grid interface is possible via the OpenCRG API.

The UTM can be replaced with a latitude and longitude available from the CRG file header

This is only a proposal so if you can suggest alternatives, we will be open. We will likely produce other formats for other applications (such as those using XML) but to store the original data in, the OpenCRG should work.

Labels context



Write a comment…

TOPS

4 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Aug 30, 2012 (view change)

Test Operating Procedures

Aerial view of Munson test area at Aberdeen Test Center

Working Test Operating Procedure List

- 1-1-010 Vehicle Test Course Severity (Surface Roughness
- TARADCOM_SignalAnalProg
- TOP 01-1-010 VEHICLE TEST COURSE SEVERITY (31 Oct 06)
- TOP 01-1-011A VEHICLE TEST FACILITIES AT ABERDEEN TEST CENTER AND YUMA TEST CENTER (27 Feb 12)
- TOP 1-1-014 Ride Dynamics
- TOP 1-1-015 Human Systems Integration
- TOP 2-2-603 Vehicle Fuel Consumption (12 Feb 1980)
- TOP_1_1_011

These will be indexed semantically and added to the knowledge base

Table of test courses with descriptions

Test Course	Description
ATC_Belgian_Block_10	"Test Operations Procedure (TOP) 1-1-010 Vehicle Test Course Severity (Surface Roughness)"
ATC_Belgian_Block_90	etc.
ATC_Belgian_Block	
ATC_Churchville_B_10	
ATC_Churchville_B_90	
ATC_Churchville_B	
ATC_Churchville_C_10	
ATC_Churchville_C_90	
ATC_Churchville_C	
ATC_Munson_Gravel_10	
ATC_Munson_Gravel_90	
ATC_Munson_Gravel	
ATC_Perryman_1_10	
ATC_Perryman_1_90	
ATC_Perryman_1	
ATC_Perryman_2_10	
ATC_Perryman_2_90	

ATC_Perryman_2	
ATC_Perryman_3_10	
ATC_Perryman_3_90	
ATC_Perryman_3	
ATC_Perryman_A_10	
ATC_Perryman_A_90	
ATC_Perryman_A	
YTC_Desert_March	
YTC_KOFA_Level_Gravel	
YTC_Laguna_Hilly_Trails	
YTC_Laguna_Levels_Trails_West	
YTC_Laguna_Level	
YTC_Laguna_Level_Trails_East	
YTC_Laguna_Paved	
YTC_Mid-East_Sec_B	
YTC_Mid-East_Start	
YTC_Mid-East_WashEnd	
YTC_MidEast_Sec_A	
YTC_Patton_Hilly_Gravel	
YTC_Patton_Hilly_Trails	
YTC_Patton_Level_Gravel	
YTC_Patton_Level_Trails	

Ontological Knowledge

The data was compiled into JSON files, and initially stored on a file directory.

We prototyped the incorporation of PSD data from stochastic test course terrains and deterministic obstacle profiles into the knowledgebase repository.

Places | Admin | Repository | Query | Help | Login

Search

Instances in graph user sorted by label

Instance	#Properties
ent:ATC 10%SoilSlope	20
ent:ATC 15%SoilSlope	20
ent:ATC 1InchBumps	20
ent:ATC 20%SoilSlope	20
ent:ATC 25%SoilSlope	20
ent:ATC 60%SoilSlope	20
ent:ATC Belgian Block	12
ent:ATC Belgian Block 10	12
ent:ATC Belgian Block 90	12
ent:ATC Churchville B	12
ent:ATC Churchville B 10	12
ent:ATC Churchville B 90	12
ent:ATC Churchville C	12
ent:ATC Churchville C 10	12
ent:ATC Churchville C 90	12
ent:ATC CrosstieCourse	20
ent:ATC ElevationStabilizationBump	20
ent:ATC MTA 18InchWall	20
ent:ATC MTA 24InchWall	20
ent:ATC MTA 2InchWashboard	20
ent:ATC MTA 36InchWall	20
ent:ATC MTA 3InchSpacedBump	20

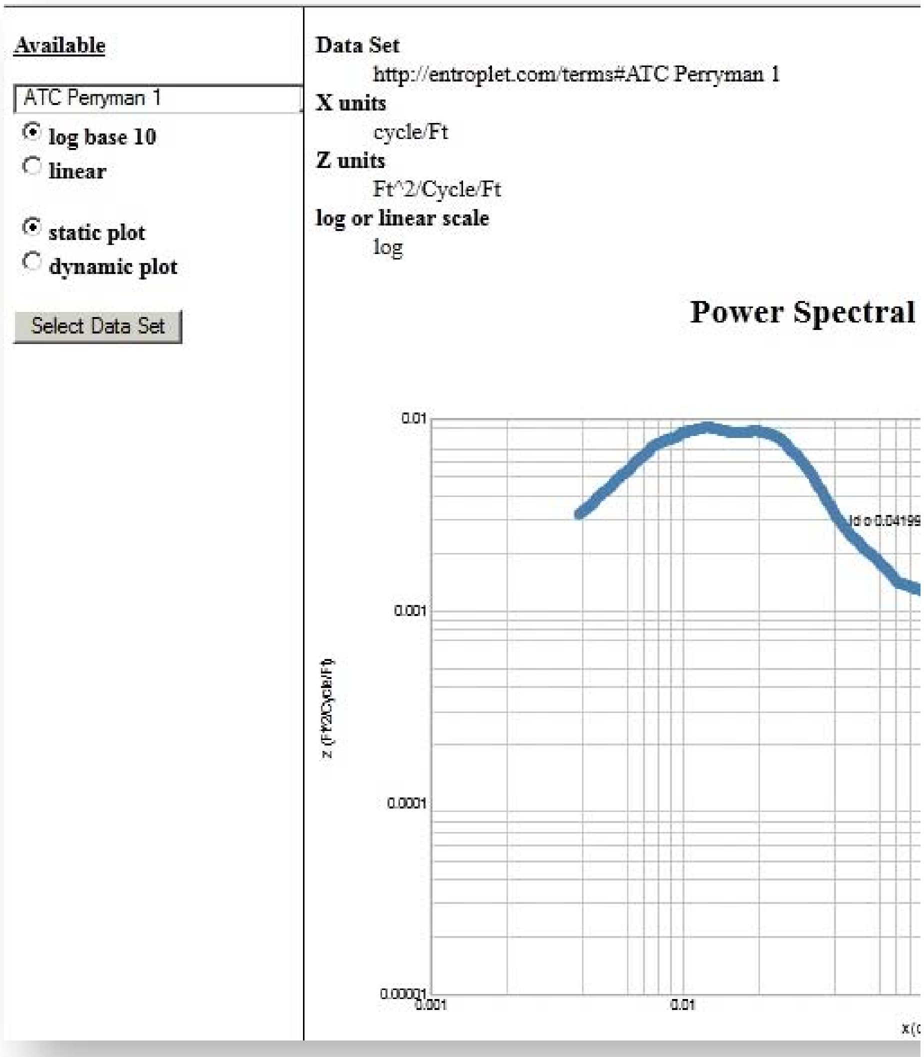
The data can be viewed from a triple-stored graph browser.

ent:data_y	[0.001192851],[0.0011796972],[0.0011667125],[0.0011546925],[0.00114317 [0.0010088689],[0.00099793769],[0.00098700328],[0.00097684167],[0.0009 [0.00089074],[0.00089074],[0.00089074],[0.00089074],[0.00089074],[0.0008 [0.00085732476],[0.00085483],[0.00085483],[0.00085483],[0.00085483],[0.0 [0.00082146982],[0.00081303926],[0.00080486891],[0.00079671453],[0.000 [0.0007402],[0.0007402],[0.00074009565],[0.00072968544],[0.00071576815 [0.00065425],[0.00065425],[0.00065425],[0.00065550136],[0.00066424436], [0.00073151935],[0.00073507758],[0.00073874488],[0.00074452003],[0.000 [0.00095022817],[0.00098365566],[0.0010254818],[0.0010692566],[0.00110 [0.001372],[0.001372],[0.0013731213],[0.0013915453],[0.0014005],[0.00140 [0.0010893837],[0.0010560023],[0.0010259966],[0.001013861],[0.00100834 [0.00098723],[0.00098723],[0.00098723],[0.00098723],[0.00098723],[0.0009 [0.0010077],[0.0010075489],[0.00099770752],[0.00098653173],[0.00098115 [0.00086644923],[0.0008397516],[0.00080881095],[0.00077240467],[0.0007 [0.00068173],[0.00068173],[0.00067941738],[0.00067053559],[0.00066346 [0.00043952708],[0.00043193131],[0.00042565181],[0.00041899718],[0.000 [0.00037498931],[0.00037106602],[0.00036719611],[0.00036338287],[0.000 [0.00032621124],[0.00032553526],[0.00032939186],[0.00033328368],[0.000 [0.00028894478],[0.0002874695],[0.00028734],[0.00028734],[0.000287772 [0.00034526257],[0.00034912677],[0.00035266085],[0.00035519652],[0.000 [0.0002659825],[0.00024971992],[0.00023442442],[0.00022009117],[0.0002 [0.00014804548],[0.00015097598],[0.00015537279],[0.00016233224],[0.000 [0.00020113077],[0.00019836875],[0.00019247865],[0.00018688459],[0.000 [0.00012158842],[0.00011990651],[0.00012025598],[0.00012104649],[0.000 [0.00012219461],[0.00011967757],[0.0001171621],[0.00011531791],[0.0001 5],[9.4160482e-5],[9.2971952e-5],[9.2695e-5],[9.2695e-5],[9.2536212e-5],[9. 5],[9.0808e-5],[9.0808e-5],[9.0808e-5],[9.0808e-5],[9.0808e-5],[9.0808e-5],[5],[8.7148e-5],[8.7148e-5],[8.7148e-5],[8.7148e-5],[8.7148e-5],[8.7148e-5],[5],[8.3635e-5],[8.3635e-5],[8.3635e-5],[8.3635e-5],[8.3635e-5],[8.3635e-5],[5],[7.5536791e-5],[7.5461e-5],[7.5461e-5],[7.5461e-5],[7.5461e-5],[7.5461e- 5],[8.0320879e-5],[7.8289931e-5],[7.6245e-5]]"
ent:date	"31 October 2006"
ent:file	"ATC_Perryman_1_logspaced.JSON"
ent:file_path	"../../../../Models/Land/terrains/grades_slopes/data/WaveNumberSpectra/LogS
ent:label_x	"Wave Number"
ent:label_y	"PSD Magnitude"
ent:name	"ATC Perryman 1 "
ent:title	"Test Operations Procedure (TOP) 1-1-010 Vehicle Test Course Severity (Surf
ent:type	"terrain_psd"
ent:units_x	"cycle/Ft"
ent:units_y	"Ft^2/Cycle/Ft"

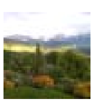
All properties reside in the graph user

The resource does not appear as an object

By adding a few query rules, we can access the data and present as a graphical artifact.



Labels context



Write a comment…

Gross Terrain Features

3 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 11, 2012 (view change)

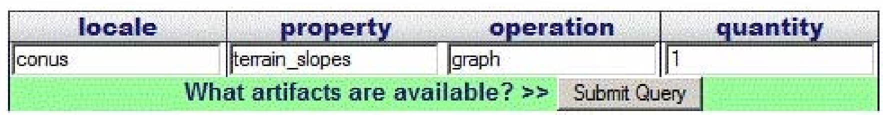
Data Sources

- USGS DEM
  A list of USA Lower 48 DEM 250 files suitable for wget download : wg.txt

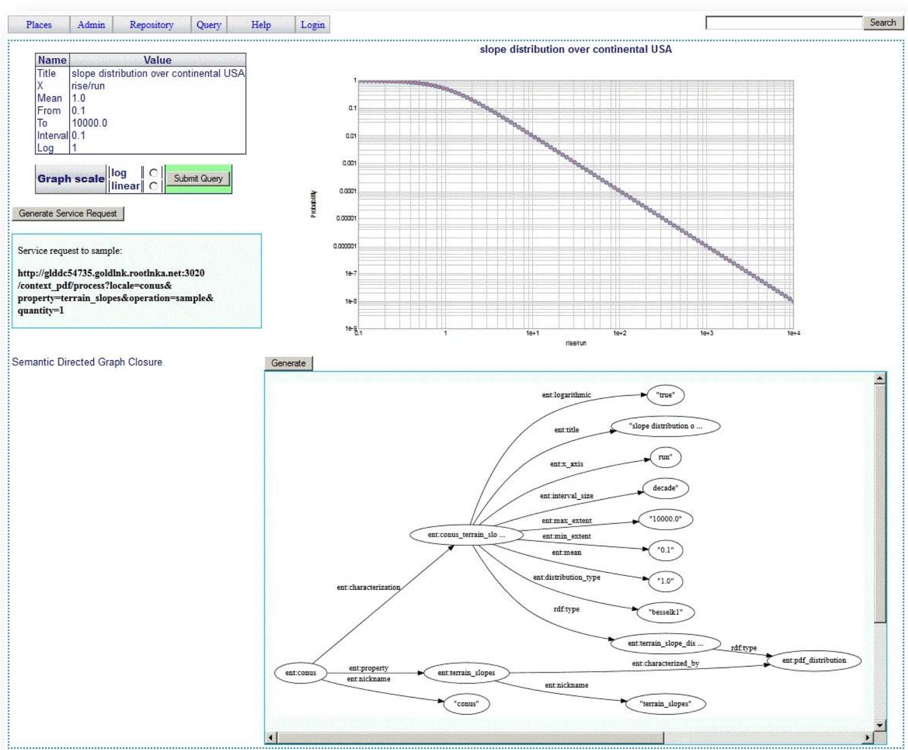
Prototype

We used the distributions described here to prototype the service.

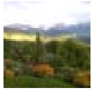
This is a general search interface to select the locale.



Once locale is selected, then services and artifacts become available.



Labels context



Write a comment…

Lake Size Statistics

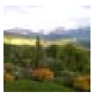
Edit Share Add Tools

Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 11, 2012 (view change)

Intro

The foundation for this work is described in the Probability Elements white paper.

Labels context

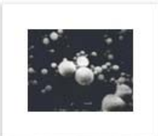


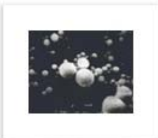
Write a comment…

Particle Size Statistics

Edit Share Add Tools

Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 11, 2012 (view change)





Intro

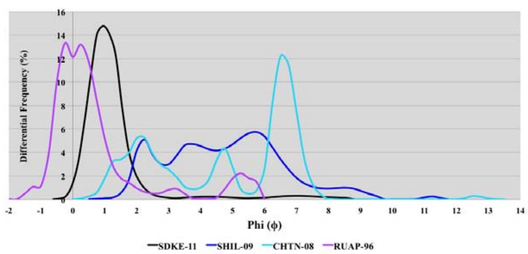
The foundation for this work is described in the Probability Elements white paper.

Data Sources

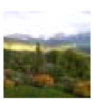
- Cloud particulates at JPL, ice
  http://mls.jpl.nasa.gov/dwu/cloud/index.html
- Volcanic ash
  Particle size distribution

Characteristics

- Wide distribution (from Wikipedia), axis Phi shows size in powers of 2



Labels context



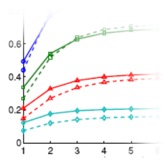
Write a comment…

Probabilistic formal model checking

Edit Share Add Tools

19 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Dec 03, 2012 (view change)

OUrandomWalk.pdf



Intro

By using stochastic models of the terrain with well-characterized probability distributions, we can use that as an input or constraining stimulus to allow for PCC estimation, and potentially formal verification.

As an example, given a statistical model of a rugged terrain region, one can formally estimate regions of excessive steepness and reason about the vehicle's ability to navigate that terrain. In the sense of sampling statistics, a simulation can also fully explore a larger state space than that available from the limited size of the empirical data set.

Strategy

Approach

Make the PRISM terrain models consistent with empirical probabilistic models. This might involve

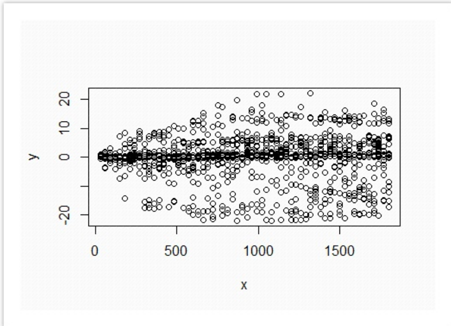
1. generating both models a from a common underlying data set, or

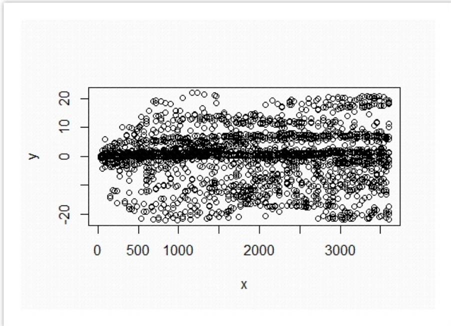
2. showing statistical equivalence of the models

For example establish the relationship elevation and slope in the models.

Data

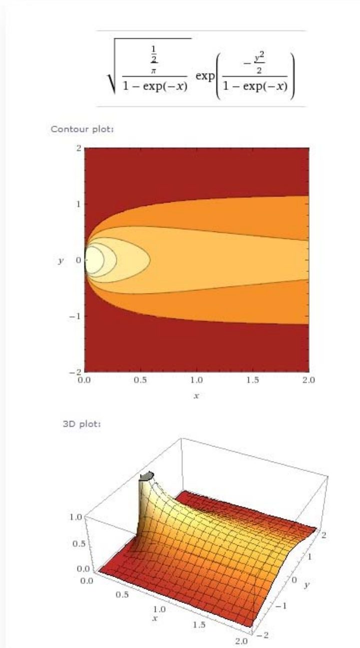
Below are example of a density plot of X-spacing and Y-elevation changes in a 10km area around Yuma. The X-spacing is in multiples of 30 m.





The short distances of <90 m show little elevation change, while the larger distances show statistically greater changes.

Below is a contour plot of the x-y marginal probability distribution of a normalized Ornstein-Uhlenbeck random walk process.

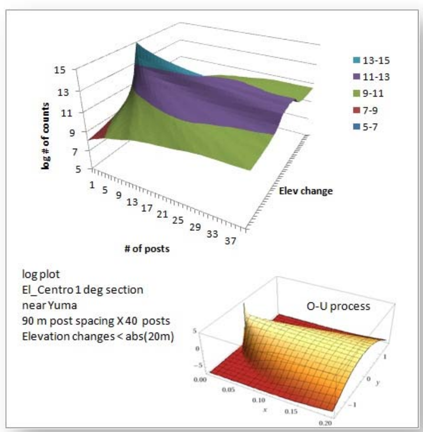


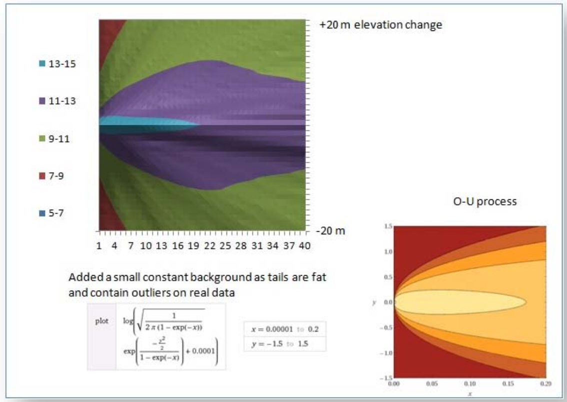
This is one the simplest stochastic behaviors that will give rise to that shape, assuming that the random walk excursions show a reversion to the mean, which is the average terrain elevation for that region.

$$f(x,t) = \sqrt{\frac{\theta}{2\pi D(1-e^{-2\theta t})}} \exp\left\{\frac{-\theta}{2D}\left[\frac{(x-\xi e^{-\theta t})^2}{1-e^{-2\theta t}}\right]\right\}$$

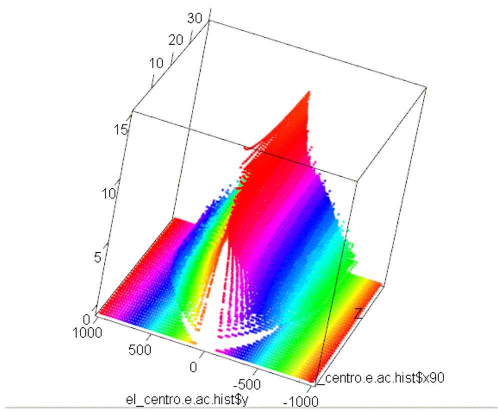
It also generates the most frequently observed PSD profile that we run across from detrended terrain data, which gives a maximum RMS value at small wavenumbers.

The following is a more comprehensive collection of data for a large section of desert terrain. To reduce the noise the DEM section named El_Centro was culled, and the log of the marginal probabilities are shown below. In the lower right corner, a scaled yet representative Ornstein-Uhlenbeck marginal probability density function is shown.





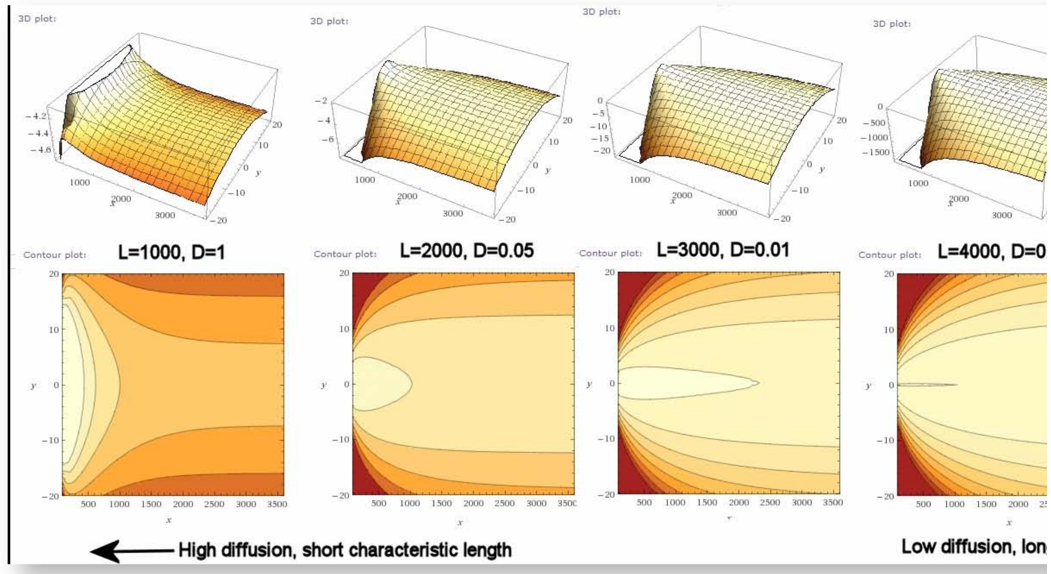
Shown below is a bigger swath where we counted all pairs (not just <20 meter changes) which starts to pick up mountainous terrain. The pair correlation function shows much more weight in flatter regions, yet the occasional mountainous slopes contribute to the tail. The intense red peaked area comprises the small elevation changes shown in the previous contour plot..



The following images demonstrate how the scaling of Ornstein-Uhlenbeck diffusion works. The two parameters are the diffusion coefficient D and the characteristic length L.

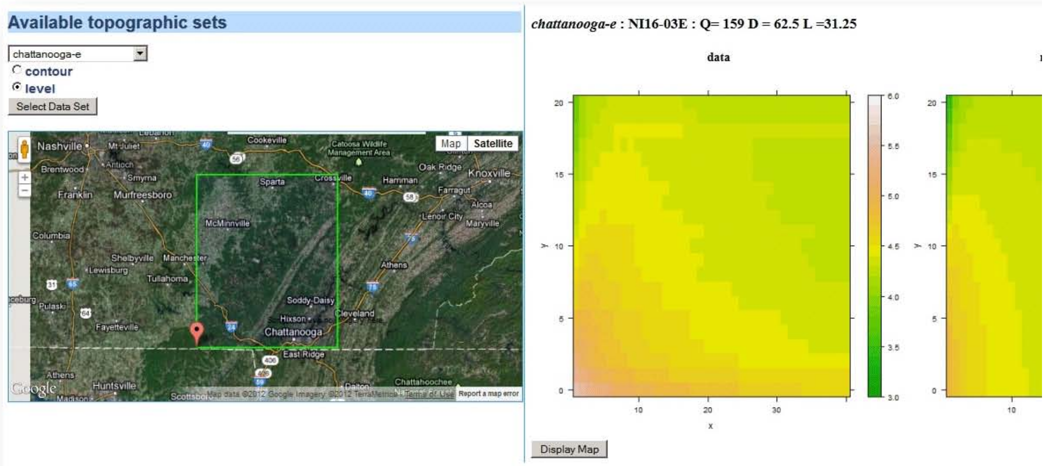
- For flat and smooth terrain, the characteristic length is long and the diffusion coefficient is low.
- For steep and rugged terrain, the characteristic length is short and the diffusion coefficient is high.

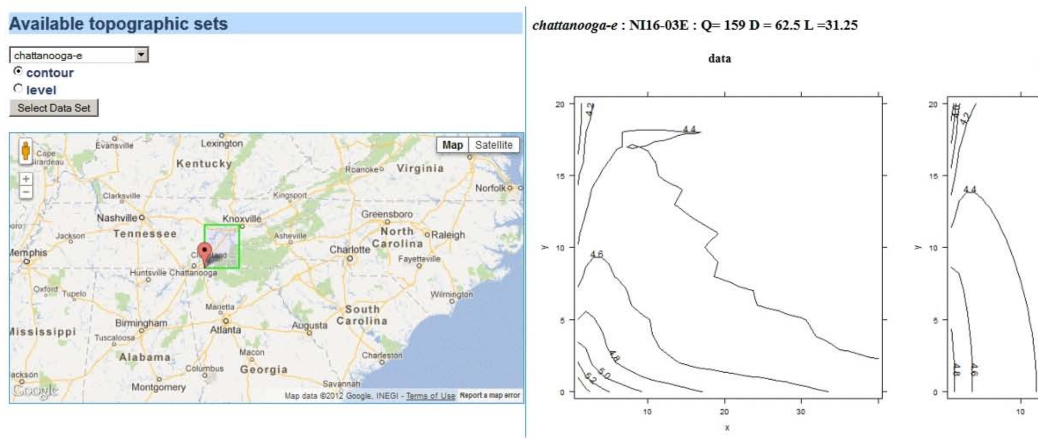
By looking at the contour plots and the shape of the peak, we can tell what kind of a terrain it is. It is also possible to have combinations of flat and rugged terrain if a large enough region is considered.



Dynamic Context Server

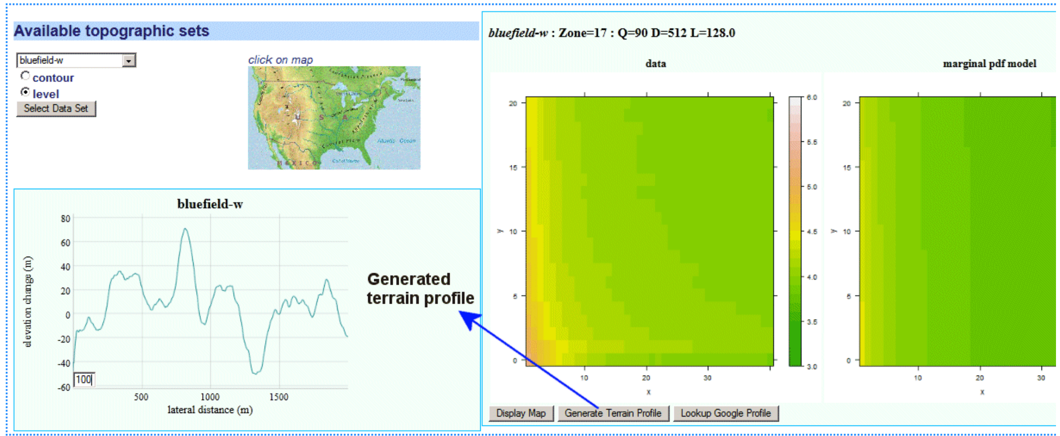
The model works very well with most topographic regions. A prototype interface is shown below in which the user can select any 1 degree section of the US lower 48 and generate a best fit match to an O-U model. A gradient level and contour plot representation for the Chattanooga region is shown below, alongside the model fit. Only the upper half of the marginal is shown due to symmetry considerations.

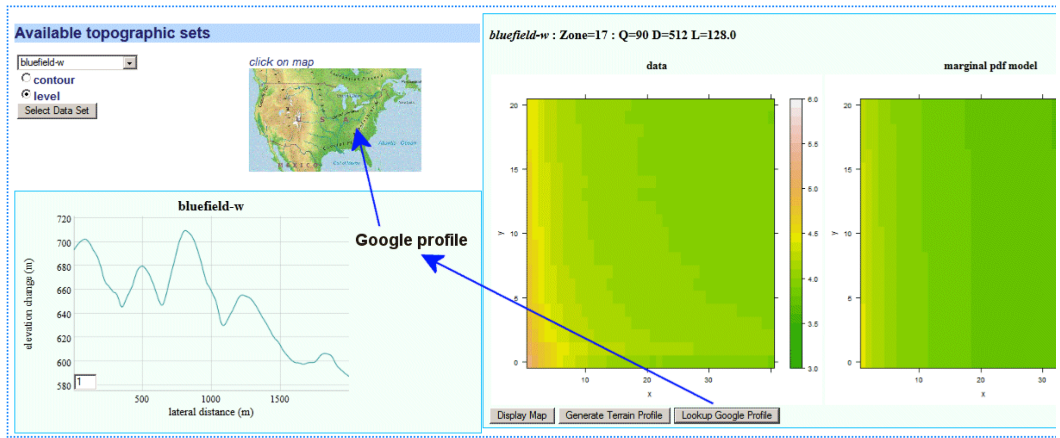




From the marginal probability distribution fit, we can generate simulated terrains which match the statistical content for that region.

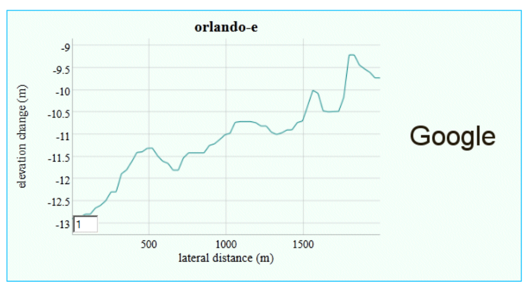
Start with a hilly region near the Smoky Mountains, where excursions exceed 100 meters in a 2000 meter interval:

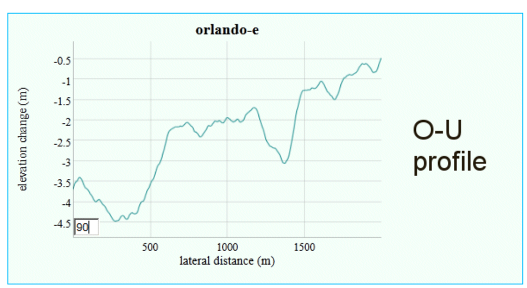




We can check the content against an arbitrary Google profile call, and note the general similarity in the width and strength of the elevation excursions

For a flatter area, consider inland Florida near Orlando: D=8.0 L=1.0





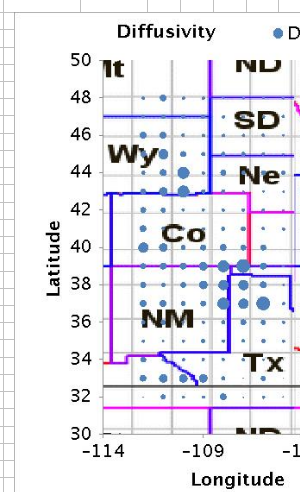
Here the relative excursions are small, ~1 meter, with gentle long range slopes comprising most of the profile.

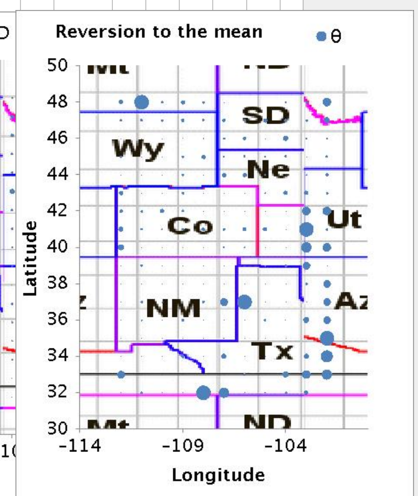
attachment, an analysis of western Great Plains and Rocky Mountains.

[dem_terrain_eval102-112_32-49.xlsx]

Edit Document

Lon	Lat		D	log D	θ	log theta	log-error (lower = better fit)			Ornstein-Uhlenbeck analysis of western Great Plains and Rocky Mountains
-112	32		16	2.772588722239781	0.000012	11.330603908176274	404		D (the random walk constant) is in terms of m^2 per post spacing which is 90 meters along the longitudinal axis	
-112	33		512	6.238324625039508	0.05	2.995732273553991	392		θ (the reversion to the mean constant) is in terms of a dimensionless drag per spacing	
-112	34		362.04	5.89175470295897	0.000035	10.26016249647486	222		The variance in overall roughness is D/(2θ)	
-112	35		90.51	4.50546034183908	0.000012	11.330603908176274	182			
-112	36		181.02	5.198607522399024	0.000012	11.330603908176274	194			
-112	37		512	6.238324625039508	0.000012	11.330603908176274	197			
-112	38		362.04	5.89175470295897	0.000012	11.330603908176274	135			
-112	39		362.04	5.89175470295897	0.000012	11.330603908176274	184			
-112	40		1024	6.931471805599454	0.035355	3.342315453925933	337			
-112	41		512	6.238324625039508	0.025	3.688879454113937	263			
-112	42		362.04	5.89175470295897	0.008839	4.728581530903327	270			
-112	43		362.04	5.89175470295897	0.0125	4.382026634673881	361		Bubble Charts	
-112	44		181.02	5.198607522399024	0.000012	11.330603908176274	191			
-112	45		362.04	5.89175470295897	0.004419	5.421841852833534	191			
-112	46		512	6.238324625039508	0.000012	11.330603908176274	206			
-112	47		128	4.852030263919618	0.00625	5.075173815233828	269			
-112	48		90.51	4.50546034183908	0.017678	4.035434350343381	387			
-111	32		256	5.545177444479562	0.003125	5.768320995793772	219			
-111	33		724.08	6.584901883518916	0.000012	11.330603908176274	216			
-111	34		90.51	4.50546034183908	0.000012	11.330603908176274	241			
-111	35		64	4.158883083359672	0.000012	11.330603908176274	293			
-111	36		256	5.545177444479562	0.000781	7.154935408124588	176			
-111	37		512	6.238324625039508	0.003125	5.768320995793772	199			
-111	38		181.02	5.198607522399024	0.000012	11.330603908176274	125			
-111	39		512	6.238324625039508	0.004419	5.421841852833534	206			
-111	40		724.08	6.584901883518916	0.000012	11.330603908176274	204			
-111	41		128	4.852030263919618	0.00625	5.075173815233828	242			
-111	42		256	5.545177444479562	0.003125	5.768320995793772	214			
-111	43		724.08	6.584901883518916	0.000012	11.330603908176274	187			
-111	44		512	6.238324625039508	0.000012	11.330603908176274	158			
-111	45		1024	6.931471805599454	0.000012	11.330603908176274	144			
-111	46		512	6.238324625039508	0.000012	11.330603908176274	184			
-111	47		181.02	5.198607522399024	0.00625	5.075173815233828	243			
-111	48		512	6.238324625039508	0.2	1.6094379124341	563			
-110	32		90.51	4.50546034183908	0.000012	11.330603908176274	282			
-110	33		724.08	6.584901883518916	0.000012	11.330603908176274	204			
-110	34		90.51	4.50546034183908	0.000012	11.330603908176274	245			
-110	35		90.51	4.50546034183908	0.000012	11.330603908176274	226			
-110	36		128	4.852030263919618	0.000012	11.330603908176274	182			
-110	37		256	5.545177444479562	0.001105	6.807909944012422	221			
-110	38		362.04	5.89175470295897	0.000012	11.330603908176274	180			
-110	39		512	6.238324625039508	0.000012	11.330603908176274	164			
-110	40		256	5.545177444479562	0.000012	11.330603908176274	199			
-110	41		90.51	4.50546034183908	0.00221	6.114762763452476	245		Examples of very high diffusivity with little reversion to the mean are the peak mountains of Colorado and Wyoming	
-110	42		128	4.852030263919618	0.017678	4.035434350343381	317		Examples of relatively high diffusivity and high reversion to the mean are the bluffs and dunes region of western Nebraska, and the	





							ravine country of North Texas.
-110	43	1448.15	7.27804215874069	0.000012	11.330603908176274	163	
-110	44	1448.15	7.27804215874069	0.000012	11.330603908176274	142	North Platte West -- Note the almost periodic nature of the relief
-110	45	362.04	5.89175470295897	0.000012	11.330603908176274	234	
-110	46	128	4.852030263919618	0.000012	11.330603908176274	211	
-110	47	181.02	5.198607522399024	0.003125	5.768320995793772	174	
-110	48	90.51	4.50546034183908	0.004419	5.421841852833534	288	
-109	32	90.51	4.50546034183908	0.000012	11.330603908176274	293	
-109	33	724.08	6.584901883518916	0.00221	6.114762763452476	241	
-109	34	128	4.852030263919618	0.008839	4.728581530903327	288	
-109	35	181.02	5.198607522399024	0.000012	11.330603908176274	226	
-109	36	90.51	4.50546034183908	0.004419	5.421841852833534	209	
-109	37	362.04	5.89175470295897	0.000012	11.330603908176274	199	
-109	38	724.08	6.584901883518916	0.000012	11.330603908176274	189	
-109	39	724.08	6.584901883518916	0.000391	7.84680299797891	155	Scott's Bluff East
-109	40	362.04	5.89175470295897	0.000012	11.330603908176274	176	
-109	41	90.51	4.50546034183908	0.004419	5.421841852833534	261	
-109	42	128	4.852030263919618	0.00625	5.075173815233828	190	
-109	43	181.02	5.198607522399024	0.003125	5.768320995793772	159	
-109	44	90.51	4.50546034183908	0.003125	5.768320995793772	145	
-109	45	181.02	5.198607522399024	0.004419	5.421841852833534	243	
-109	46	90.51	4.50546034183908	0.000552	7.50196251168718	267	
-109	47	181.02	5.198607522399024	0.008839	4.728581530903327	184	
-109	48	90.51	4.50546034183908	0.0125	4.382026634673881	288	
-108	32	512	6.238324625039508	0.2	1.6094379124341	325	
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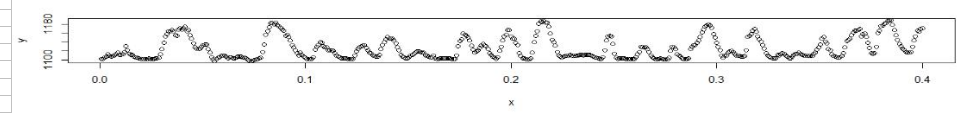

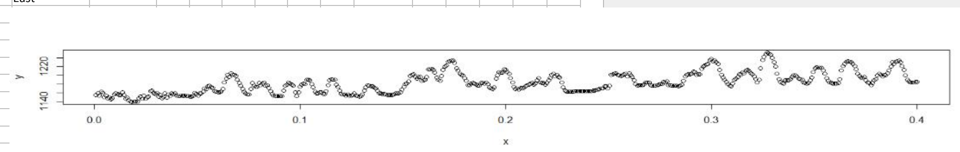

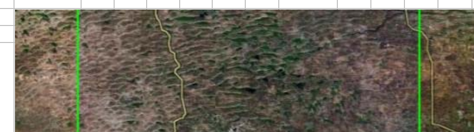

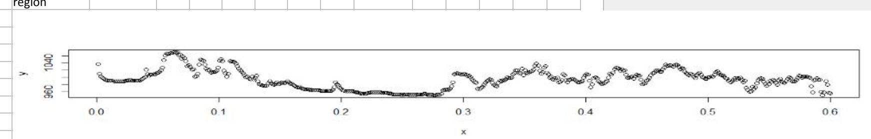

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Description of uncertainty-quailified Ornstein-Uhlenbeck

Optimization

We have essentially been working with two models:

1. The original Ornstein-Uhlenbeck Gauss-Markov model, with a given D and Theta for a region
2. The uncertainty quantified OU model, with a Maximum Entropy distribution for D (see the comment at the bottom of this page)

For the plurality of the DEM sites, the MaxEnt model seems to work better than the OU model, as it captures better the curvature in the contours.

However, on occasion the original model works very well.

So a thought is that an uncertainty somewhere in-between “no uncertainty” and “max uncertainty” may work to capture the majority of the sites.

As “in-between” prior distribution we pick:

p(D) = 0.5*D/<D> exp(-D/<D>)

which is a gamma, one order higher than an exponential, showing a very broad peak around the average diffusivity <D>. The MaxEnt model has an average of <D> as well but it the mode is at <D>=0, which may be too much flatness smeared into the distribution.

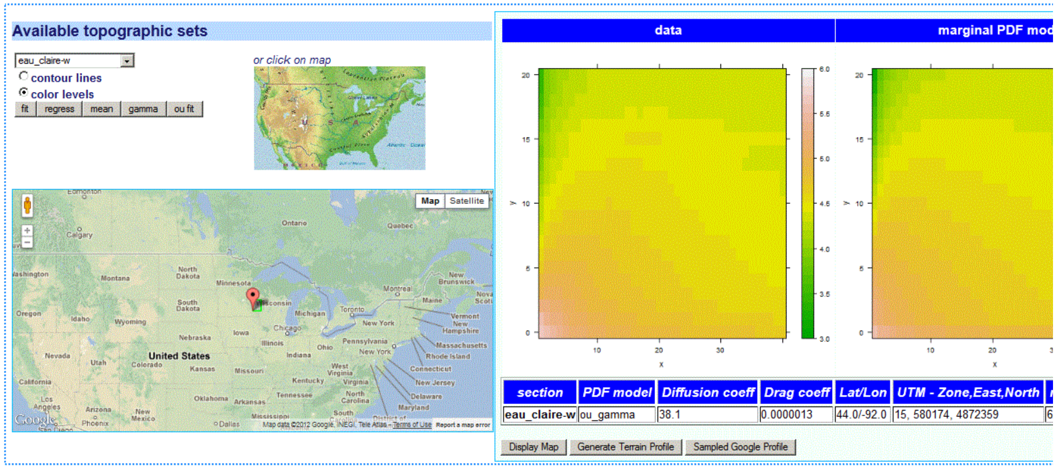
The fortunate outcome of this choice is that the marginal distribution still has a closed form for the solution, and is not that much more complicated than the simple exponential for the MaxEnt choice.

p(x|z) = (sqrt(D*x) + z/2)/(D*x) * exp(-z/sqrt(D*x))

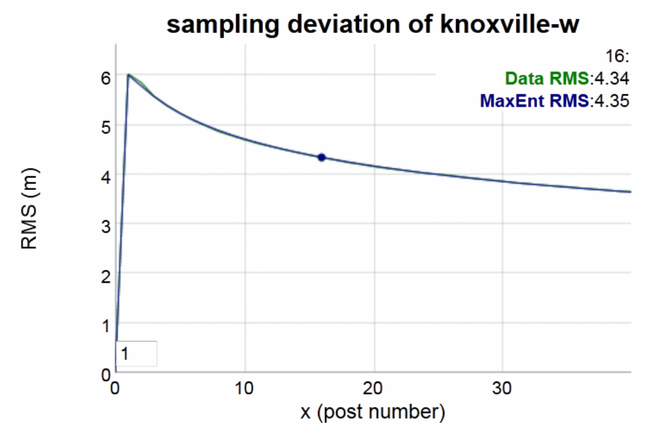
where x is the OU transformed distance parameter (1-exp(-Theta*X))/Theta and z is positive.

It works very well for all the hilly sites in the Midwest such as in SW Minn, SW Wisconsin and N.Iowa. On some sites, the errors are as small as when running the curve-fitting routine with a noise-free synthetic profile .

The attached GIF is for the Eau Claire section. This is probably as good as we can get apart from improving on the MLE approach.



As a comparison between a model and data, we can apply a sampling variance to the two sets.The sampling variance is the expected RMS excursion about the mean.



The RMS is truncated to elevation changes < 20 meters, due to limited sampling

Labels context

2 Comments

Pukite, Paul R [BAE Systems]

Jul 09, 2012

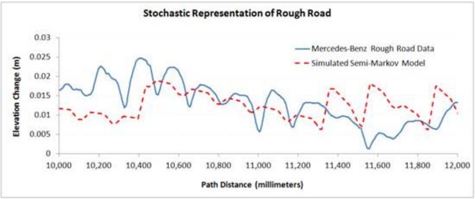
> *Need to figure out how to get some real numbers to put into the PRISM terrain models we're creating. We have two general approaches.*
>
> *1. 'Memoryless,' where there is no relationship between adjacent locations. This would just be a histogram (of discrete probabilities) based on some chosen resolution. Should be similar to the current simulation-based context models.*
>
> *2. Markov model, where we compute a transition probability matrix based on autocorrelation of the terrain data.*
>
> *How to create the statistical data we need? I'm assuming we can demonstrate the concept using the CONUS digital elevation data (or some subset).*
>
> *Will it be easier to work with elevation or slope? If we use elevation, we'll just compute slope afterwards in the model.*
>
> *What are reasonable resolutions, both for the elevation/slope data and for the horizontal/position axis?*

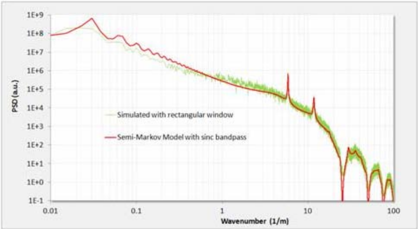
However we get the data, the end result will be to cast it into an autocorrelation function, as that is where the connection to a Markov model becomes relevant. Autocorrelations for continuous profiles have to be treated with care because we are trying to describe two characteristics with essentially one function, that is the probability of making a transition as well as the size or slope of the transition.

I have some definite ideas on how to go forward. I think the most interesting track to follow is to use the PSD information to extract the autocorrelation function.

If we assume discrete steps, we can use the algorithms out-lined in the paper to formulate an AC function. So the forward process is to devise a random walk Markov or semi-Markov model that can generate a stochastic terrain profile of discrete steps. We can then simplify fitting an AC by transforming it into a PSD. The art in this is to modify the Markov and semi-Markov transitions until the features of the actual PSD match the model PSD.

The process is to iterate on this until we get a good fit. If there are interesting features in the PSD, such as sharp spectral peaks, the convergence is rapid. The AC is the inverse Fourier transform of the PSD, so that part becomes automatic and you have the conditional probability for making a step transition. The random walk generation of the terrain profile also becomes automatic and those parameters can go into a step transition matrix, which then allows us to linearize the steps into slopes. The random-walk model will then statistically mimic the actual terrain and you end up with something like this:





Note that the dashed simulated course statistically matches the actual course. And this is the PSD the random walk model is derived from is the chart below it.

The best way to show how this works is to take data from a course that is not completely Markov random but that has some quasi-periodic elements to, like a mogul course, a washboard course, or something with longer periods. I have been doing this with cobblestone (see above), pothole, and short-wavelength washboard courses where the structure is finer and the PSD characterization works very nicely. I know that you want to try it on longer courses with longer-wavelength features, and any higher-resolution DEM, DTED, etc data sets will be pretty good for this. I am sure we can find some interesting rugged terrain, for example land with high amounts of rainfall erosion.   It really can't be what is called a multi-scale kind of terrain profile because the autocorrelation will need to keep track of the correlations on these different scales, as the biggest macroscopic slope changes will wipe out the smaller changes. This is also discussed in the paper, and why detrending of slopes is necessary.

The other approach of a memoryless process is much easier but it suffers from not having a good handle on how long to retain a slope along the path. You can't have it change randomly every lateral increment because that would turn it into a white noise signal. But if you have a model for maintaining a spatial span for that slope, then we are generating a kind of semi-Markov model.

So I think the first step is to find a representative terrain profile. It doesn't have to be sanctioned from a test course.

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Pukite, Paul R [BAE Systems]

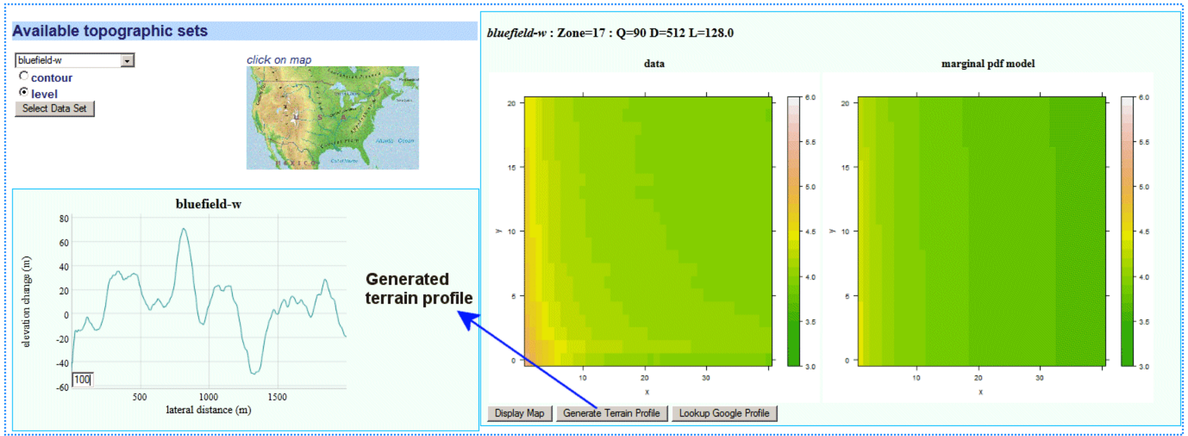
Oct 16, 2012

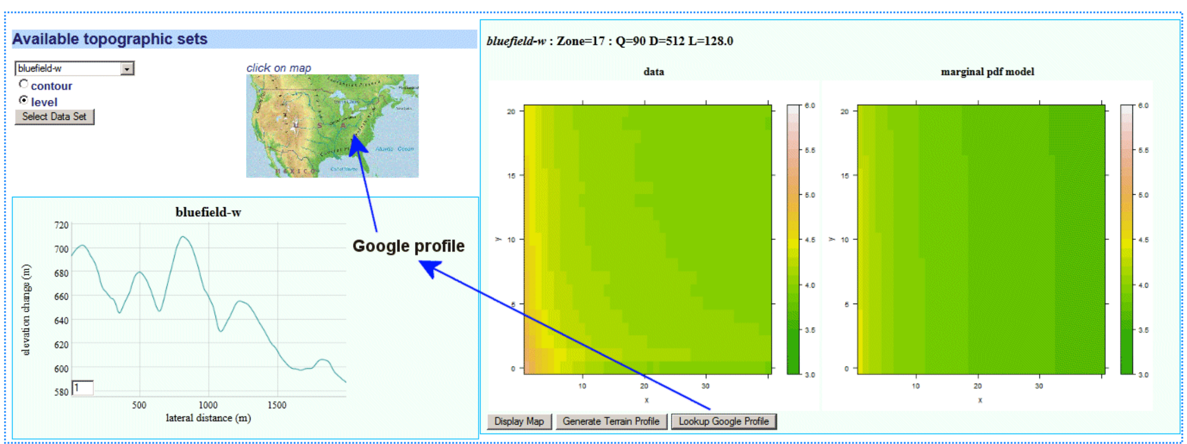
Richard,

I think setting the Epsilon to zero is the correct choice as it is just a deviation from the steady-state value. The way to think about the Epsilon is that it is part of the geological process that goes into erosion, etc, which generates the filled-in-valleys, but we do not see that in human time. Instead, we are dealing with the stationary terrain characteristics.

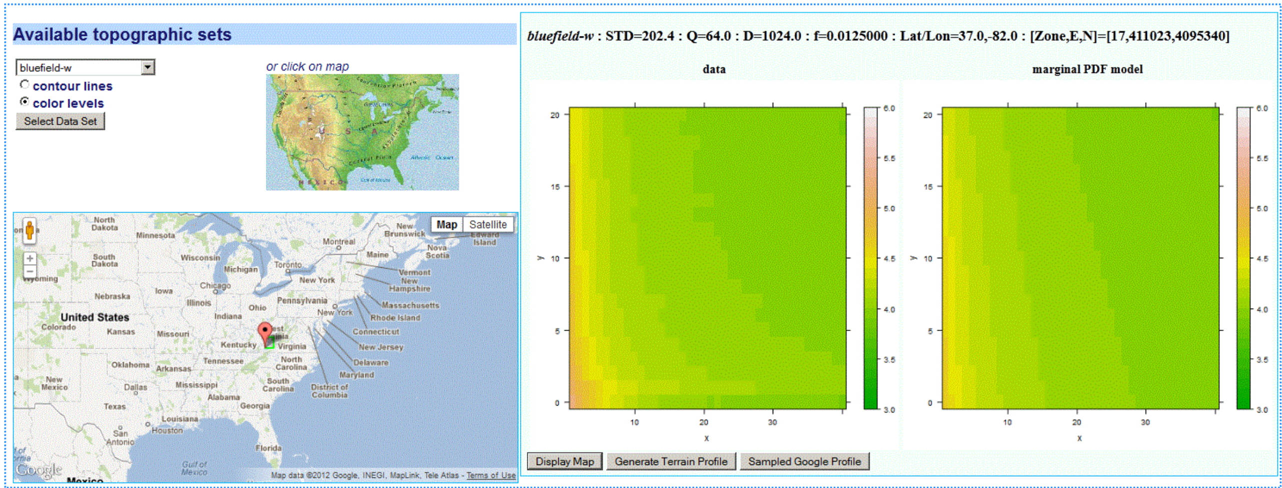
About the mixing factor, I am glad you mentioned that. I played around with creating a Maximum Entropy distribution of diffusivities, D, and then integrating that into the Ornstein-Uhlenbeck formulation. The final form is pretty simple, and what is astounding about it is that it fits the marginal distributions very effectively.

Try the visual comparison yourself. I attached the original Ornstein-Uhlenbeck fit for the bluefield-west quad in the wiki.



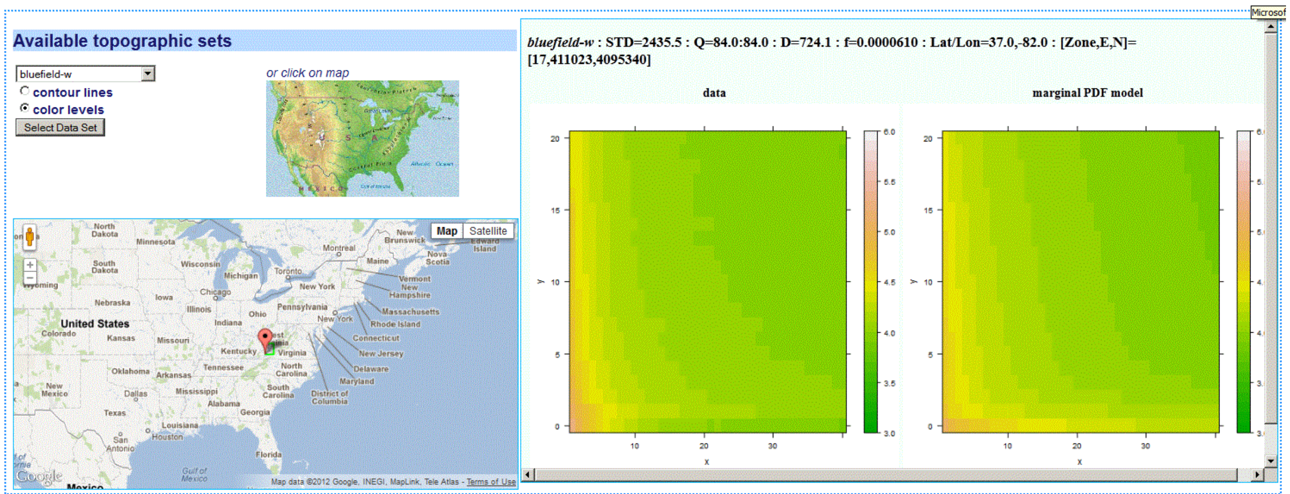


And then in comparison, the "smeared" version of the O-U model applying MaxEnt to D. Notice that the contours start to bend more, except for the very flat regions.



This is essentially moving from a Gaussian to a damped exponential distribution, which makes the tails fatter.

The next stage is to add on a fraction of a very low diffusion. That is the third curve.   I only added in a 1% mixing factor on this probability and you can see how strong the effect is.



What this means is that just about every section of land has some very flat region, either caused by farming or road grading, or some natural process such as rivers or lakes or by long-term sedimentation in valleys.

This may be worth pursuing in the time we have left. The danger is that we add additional parameters and one can fit just about anything with more than 3 parameters. As it turns out, the MaxEnt does not add an additional factor, which means that a standard mixing probability with a very small diffusion coefficient is all that is needed. The math is also very simple.

Paul,

Thanks for the clarification. When you say "Ignore the Epsilon factor" I assume you mean set it equal to 1? Or do you mean set it equal to zero so that we're talking about deviations from the current elevation?

Here's a slightly unrelated question I forgot to ask earlier -- We talked the other day about mixing distributions (when you were mentioning the different "contour" lines that hugged either the vertical or horizontal axes of the graphs). I was trying to remember if you suggested what forms of distribution we might explore for the mixture components -- were you thinking about normal and Pareto, for example? Or maybe normal and lognormal? Or something else? It's okay if you don't have a definite suggestion; I'm just trying to remember if we talked about one.

Thanks,
--Richard

--

Richard,
In that O-U formula (which I swiped the GIF from somewhere else) t represents the horizontal surface travel, while x represents elevation excursions.

The only two parameters that depend on latitude and longitude are D and Theta. Ignore the Epsilon factor as that is only used for perturbed forcing functions, and since the terrain is in steady state this can be ignored.

So the way to read the formula is as a conditional marginal probability. The probability that a shift in elevation x occurs after a distance travelled t.
p(delta elevation|distance traveled) = f(x,t)

So in an application, say we wanted to determine the average elevation change for a range in distance travelled. Then
p(delta elevation) = integral p(delta elevation|distanced traveled) * p(distance traveled)

which is a variation of how it would get applied to a formal model checker.

A PCC calculation to determine how often an elevation threshold is exceeded for a range of travel requirements is
P(delta elevation > Threshold) = integral from Threshold to infinity of p(delta elevation).

One can do similar calculations for slopes, converting the elevation changes over distance travelled to average slopes.

This may be pedantic, but I want to write some of this down for illustration.

The part that takes some care is getting the calibration correct. The post data is fixed in latitude and longitude spacing, but longitudinal spacing changes with latitude, while latitude spacing is fixed. So the post intervals are 90 meters apart and that is what the values of D and Theta are calibrated to right now. So assume the granularity of distance is a football field and then apply the Onstein-Uhlenbeck formula.

Feel free to add stuff to the Wiki, as I will add this as a comment.

--

Paul,

Thanks for sending this. I looked at it a little bit yesterday and am planning to spend more time on it today. I do have a couple of questions. First, are you still using the Ornstein-Uhlenbeck formula

or a simplified version? (Are you assuming, for example, that t is approaching infinity?) If you're not simplifying it, what values of t and Xi (i think) are you assuming in the O-U formula? Also, are you fixing latitude and picking x values that correspond to degrees of latitude?

Thanks,
--Richard

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Rainfall Statistics

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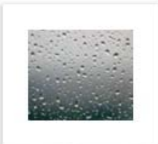
Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 11, 2012 (view change)



Intro

The foundation for this work is described in the Probability Elements white paper.

Labels context

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SemanticContextWeb

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Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Nov 16, 2012 (view change)

Installation Guides

Dynamic Context Server (DCS)

Source Code

All source code is available on SVN under the `context` branch

browser: https://babelfish.arc.nasa.gov/trac/avm_performers/browser/context

checkout: https://babelfish.arc.nasa.gov/svn/avm_performers/

Packages Required

1. SWI Prolog for Linux, Windows, or Mac http://www.swi-prolog.org/Download.html
2. R Statistics package http://www.r-project.org/
3. AT&T Graphviz graphics package http://www.graphviz.org/
4. Firefox preferred, but Google Chrome adequate as a browser. Internet Explorer won't work.
5. (possible) Geospatial indexing library http://www.swi-prolog.org/pldoc/package/space.html

Make sure to install all the add-on packages for SWI, as necessary when built from source. The prolog runtime will need to know the path to R and Graphviz. The geospatial indexing package needs to be added to the SWI Prolog build to work.

Once the SVN is checked-out, go to `context\Ontology\reasoners\prolog\proto_context_server` directory to start the Dynamic Context Server.

- `run.pl` (Windows registered)
- `run.sh` (Linux command line, change path to include Prolog exec as needed)
- "" (Mac command line, requires X windows server such as Quartz)
- `nohup-run-cloud` (running on a Cloud server as a job)

The port is 3020 for local clients and 80 for cloud configured. If you have the DCS set up on the machine you are using to access this Wiki then click on the following link: http://localhost:3020

An authorization login is required to load the ontological context data (menu item `Repository/Load Context Data`). This can be reset by removing the users.db file in the store directory.

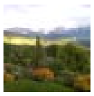
Example cloud configuration: Amazon Linux AMI x86_64 EBS, 8 GB image size

OSCAR

Source Code

Packages Required

Labels None



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Stochastic Models

2 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 04, 2012 (view change)

We propose to use patterns to model the stochastic characteristics of the environmental contexts.

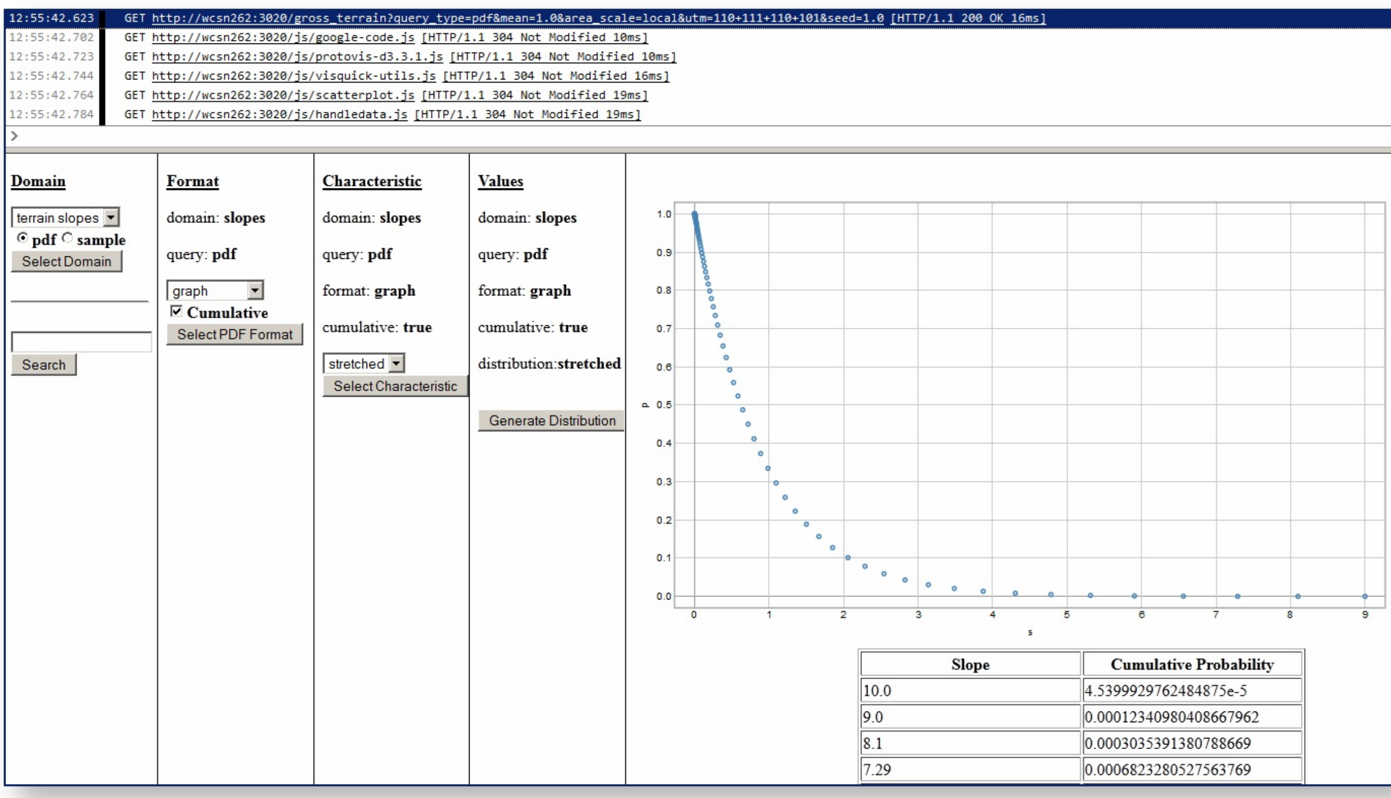
Patterns:

- Probability Elements
  Stochastic Analysis for Context Modeling
- Terrain Spectroscopy
  Unified characterization of surface topography for vehicle dynamics applications
- Dispersion Characterization
  Characterizing diffusive growth by uncertainty quantification :

These models will get tied together via a semantic web architecture, which will link to the earth sciences ontology of SWEET.

The following figure is a snapshot of a prototype that guides the generation of an environmental model or environmental model artifacts.

Probability Elements :: Domain → Format → Characteristic → Values → Results

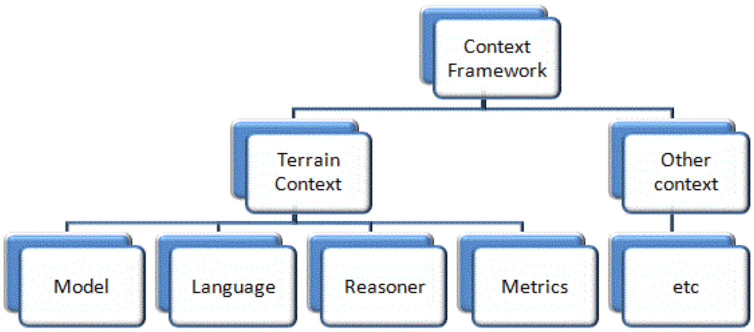


Slope	Cumulative Probability
10.0	4.5399929762484875e-5
9.0	0.00012340980408667962
8.1	0.0003035391380788669
7.29	0.0006823280527563769

1. Domain: select the context modeling domain and the main feature to model from that domain
2. Format : depending on the domain context select a specific format to express that model in, i.e. graph, table, FMU code, etc.
3. Characteristic : narrow down on the probability or stochastic characteristic of that model
4. Values : depending on the nature of the model, select range constraints, parametric values, or semantic relationships to existing geo-spatial knowledge (options not shown)

This meta-pattern for generating models will be repeated for other context modeling categories.

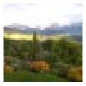
Organization



Labels context

4 Child Pages

- Dispersion Characterization
- Environmental Model Artifacts
- Probability Elements
- Terrain Spectroscopy



Write a comment…

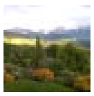
Dispersion Characterization

1 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Aug 09, 2012 (view change)

A white paper is in the works called "Characterizing diffusive growth by uncertainty quantification".

Attached is a draft version: diffusive_growth.pdf

Labels context



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Environmental Model Artifacts

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Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 04, 2012 (view change)

Metrics

...

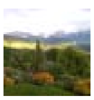
Charts and Graphs

...

Diagrams

...

Labels None



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ContextModelsCSIR

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8 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 10, 2012

CSIR provided interim deliveries of three tracks:a corrugated course, a Belgian block course, and a fatigue course

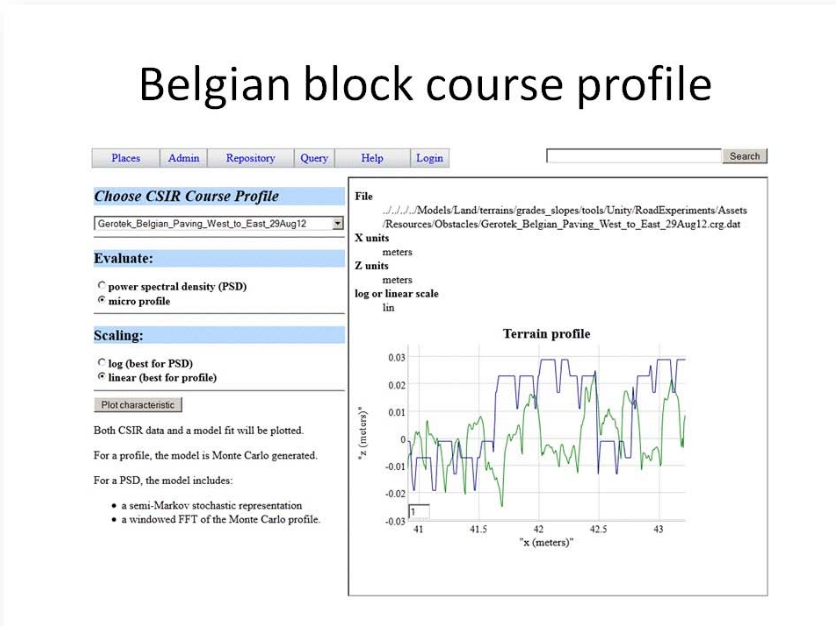
CSIR course analysis

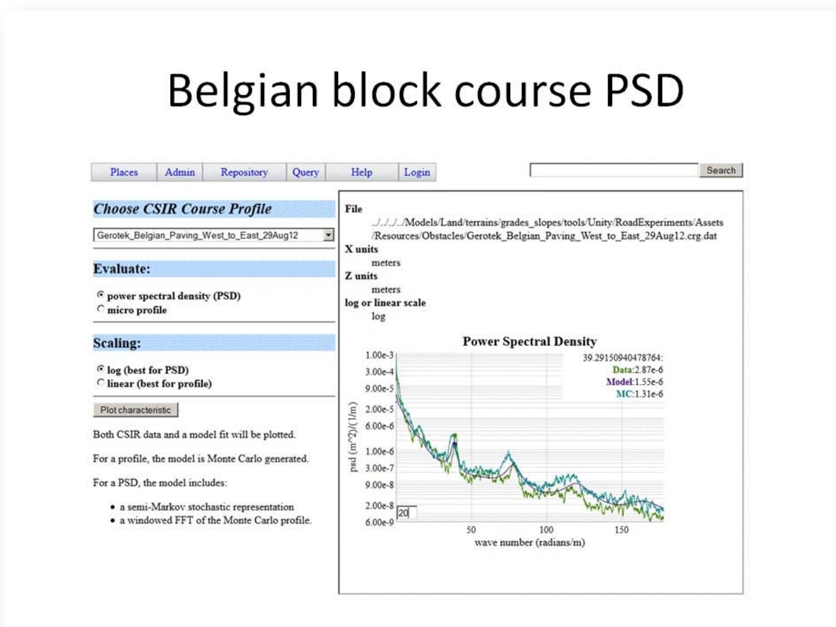
Green curves are data

Blue curves are models

- [Belgian Block course]
- [Corrugated Course]
- [Fatigue course]

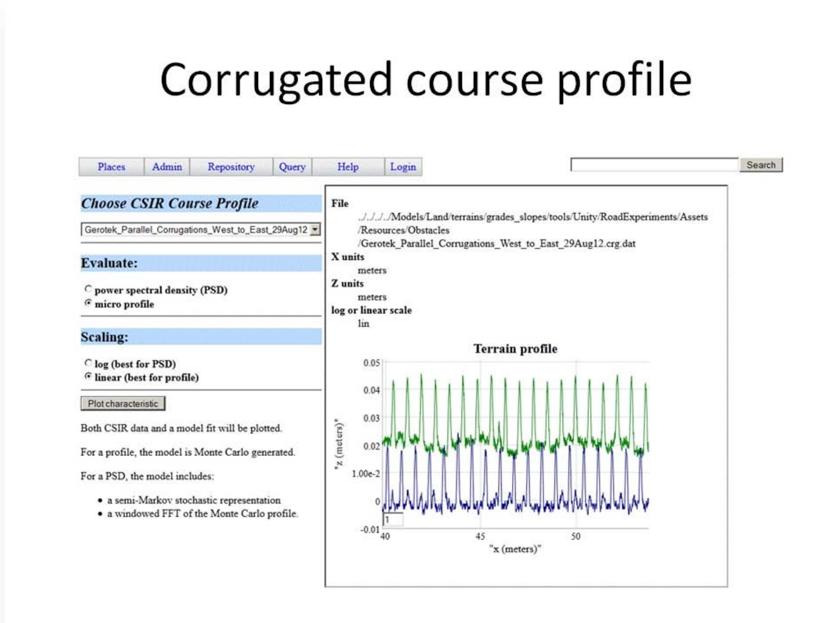
Belgian Block course

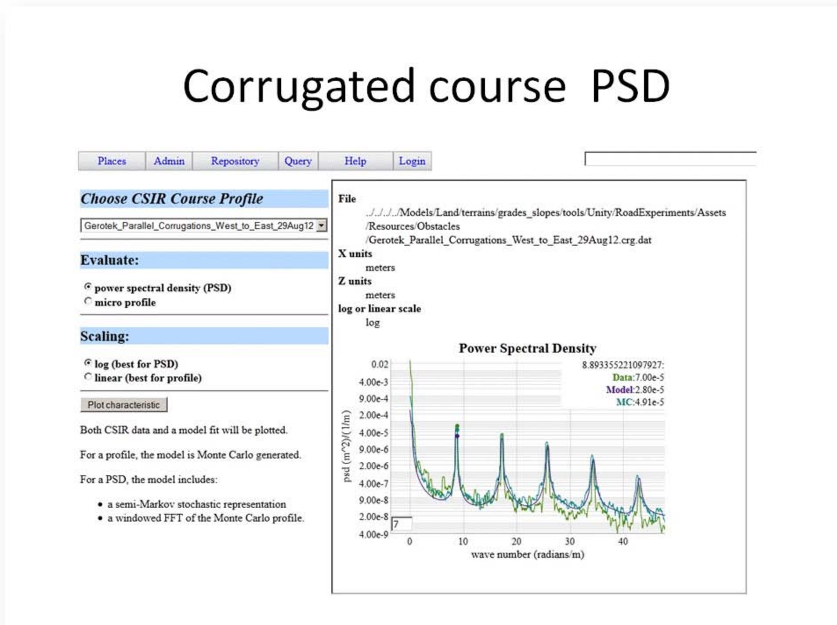




Corrugated Course

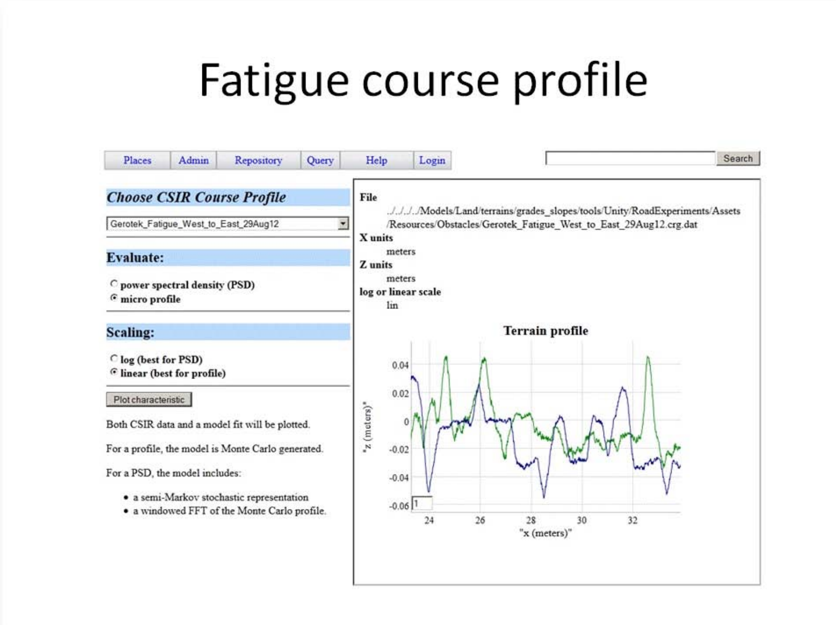
This model used a windowing filter to take off some sharpness of the step edges.

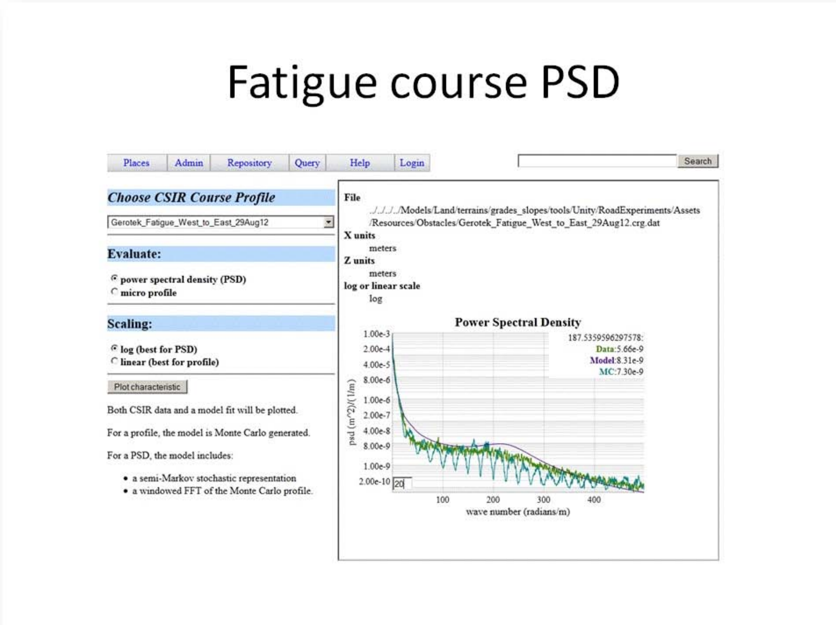




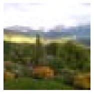
Fatigue course

This also used a windowing filter, but much larger to emulate the sloped rises and declines on the protrusions. The harmonics seen in the FFT PSD of the model are due to the rectangular window used. The analytical model used a Lorentzian window, which has a smooth envelope in the frequency domain.





Labels context



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Thermal Dispersion

4 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 05, 2012 (view change)

Thermal models are divided into localized effects featuring conduction and convection behaviors and nominal climate models which create a passive environment. See Dispersion Characterization for the former.

Design Example

The attached PDF file XV-Thermal-Manag-forMETA-v4b-11.Aug.11.pdf and forwarded email gives an example of a vehicle cooling system model sugegsted for our context work. So in this case we will likely provide an external environment context (nominal/extreme ambient temperatures, solar insolation, etc) for the vehicle.

Temperature Records

For Camp Lejuene, the Wilmington site and the Morehead City site are equally close from the NWS records.

http://www.erh.noaa.gov/

The historical data at the Wilmington location is in a PDF file, so we have to dig the parameters out manually. The Morehead City page had a slot but no data. Baltimore had a text file. This is called “unique local data”.

See the attachments for the difference between Baltimore (for Aberdeen Proving Ground) and Wilmington (for Camp Lajeune). These are expected value models taken from National Weather Service records. I would describe it as a nominal model, and will give the “normal” temperature that a weather forecaster would provide for any calendar date and time-of-day. It doesn’t provide statistical moments. This includes a prototyped function on the last sheet. The input is in days since the first of the year, so noon on January 1st would be input as 0.5. Noon on the last day of the year would be 364.5.

Some of the non-uniformity in reporting is being addressed by NOAA, and they have recently deployed the U.S. Climate Reference Network to streamline the reporting:

http://www.ncdc.noaa.gov/crn/

On our team we have the maintainer of a uniform oceanography data set, Thomas Huang, and he has some good ideas on how to pull this data together.

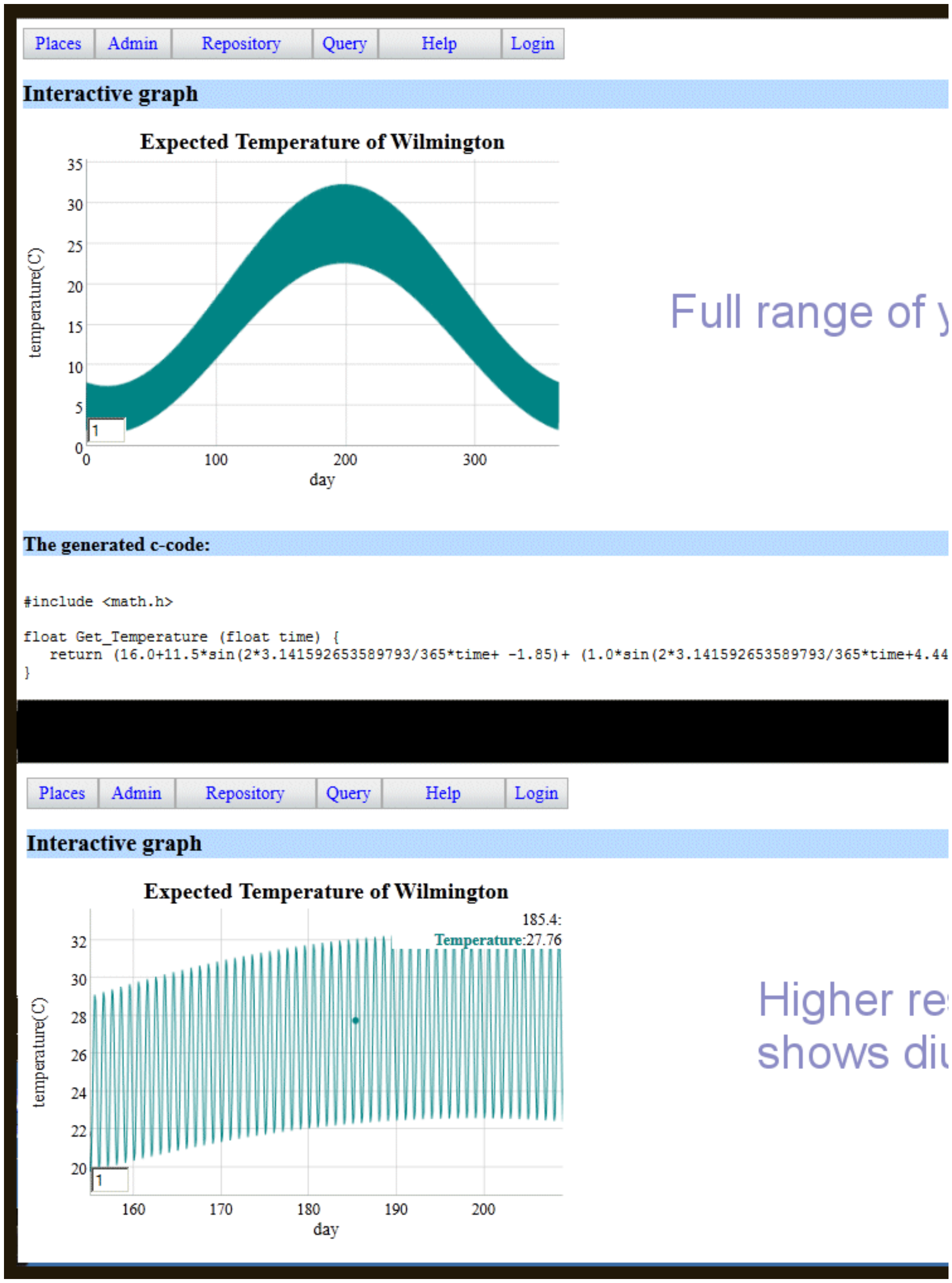
http://podaac.jpl.nasa.gov/dataaccess

We are set to create a semantic architecture that uses geospatial reasoning to pull in appropriate data. The geospatial functionality is very useful for inferring information. For example, say that temperature statistics are not known for a particular area, but data from nearby locations is available. A geospatial engine can aggregate and select data from weather stations in close proximity and use that to interpolate the statistics.

daily_temperature_baltimore.xlsx

Prototype

This is a screenshot of a prototype for generating artifacts and code.



Labels context

1 Comment

Pukite, Paul R [BAE Systems]

Jun 18, 2012

in reference to : XV-Thermal-Manag-forMETA-v4b-11.Aug.11.pdf

From: Wiedenman, Nathan
Sent: Thursday, November 03, 2011 8:56 AM

AVM PI's:

We have been working with Carnegie Mellon University for some time to put together a coherent set of models (geometric and thermal) representing the cooling system on a generic large unmanned ground system (the geometric models are posted, the thermal models will be posted shortly).Those models are done and posted on SharePoint at 'AVM Collaboration / Code Repository / iFAB / CMU.' I have also attached an overview from the

CMU folks that describes system operation.

The intent of this model set (which includes a BOM and assembly models) is for the community to utilize them in your various ongoing efforts, be they under iFAB (foundry configuration, CNC instruction generation, etc.), vehicleforge.mil (library management, version control, etc.), or META (seed design from which to branch). Paul and I encourage you to utilize these models in your work.

The geometric models use SolidWorks, and the thermal models utilize the Kuli software package. CMU is currently working to generalize the thermal data so that it can be utilized in other software environments. If you have questions or concerns please direct them to me – if there is enough discussion to justify it, we can set up a conference call with the CMU reps.

Thanks, and we'll see you in Providence!

Nathan

LTC Nathan Wiedenman, PhD
PM, DARPA TTO

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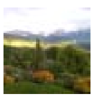

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Probability Elements

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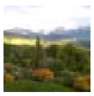
1 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Aug 09, 2012 (view change)

A white paper is in the works called "Stochastic Analysis for Context Modeling".

Attached is a draft version: stochastic_analysis.pdf

Labels context



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Terrain Spectroscopy

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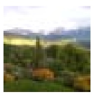
1 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Aug 09, 2012 (view change)

A white paper is in the works called "Unified characterization of surface topography for vehicle dynamics applications".

Attached is a draft version: terrain_characterization.pdf

Labels context



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Wave Energy Statistics

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5 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Nov 20, 2012 (view change) show comment

Data Sources

- Coastal Data Information Program
  This has information for coastal engineers and scientists. An example of a query
  Main Menu: http://cdip.ucsd.edu/?nav=historic&sub=data&units=metric&tz=UTC&pub=public&map_stati=1,2,3
  Around San Diago: http://cdip.ucsd.edu/?nav=historic&sub=map&units=metric&tz=UTC&pub=public&map_stati=1,2,3&xmap_id=9
  Santa Cruz Island: http://cdip.ucsd.edu/?nav=historic&sub=data&units=metric&tz=UTC&pub=public&map_stati=1,2,3&stn=182&stream=p1
  Select Interactive Spectral / Energy Spectrum from the selector box, this gives a PSD
  http://cdip.ucsd.edu/?nav=historic&sub=data&units=metric&tz=UTC&pub=public&map_stati=1,2,3&stn=182&stream=p1&xitem=product25&xyrmo=201206&xwait=2
- US Army Corps of Engineers Wave Information Studies
  This data consists of flat files for the coastal USA and the Great Lakes

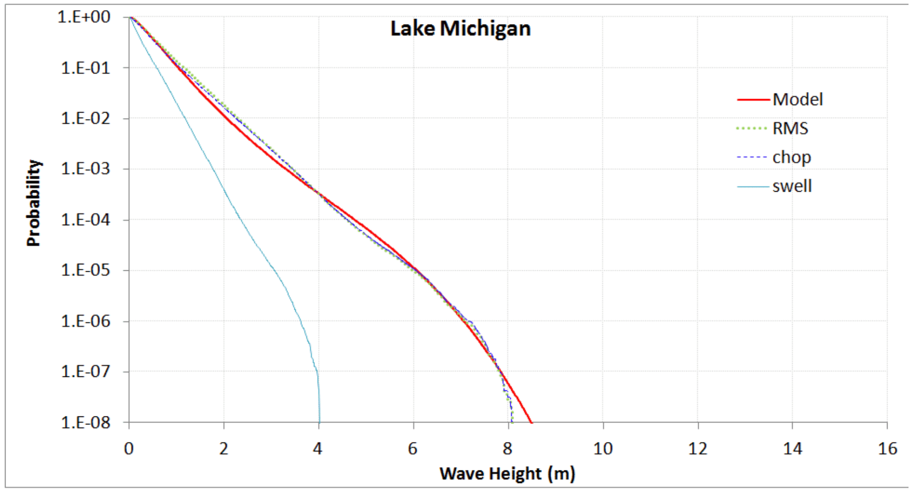
Properties

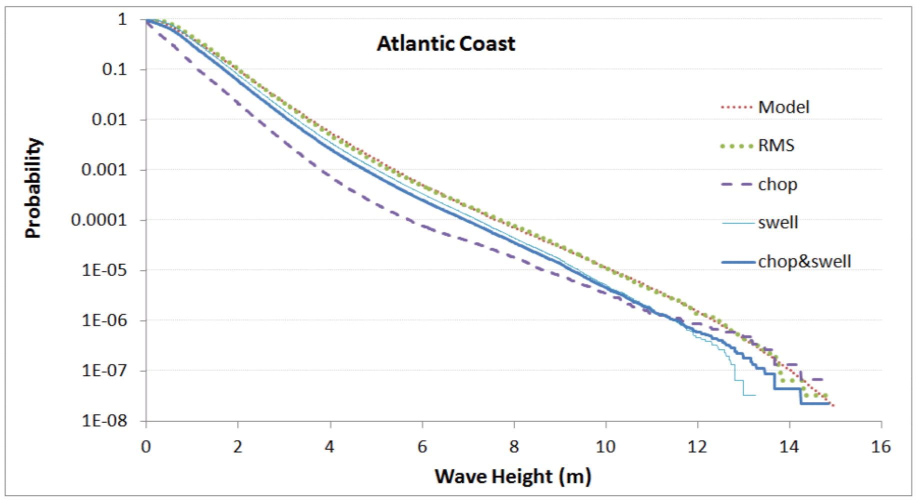
This is a sea-state classification table. The grayed column is dependent on the distribution of the wave height for a particular location. Lakes will be less rough than oceans, in general, so will have different probability transitions.

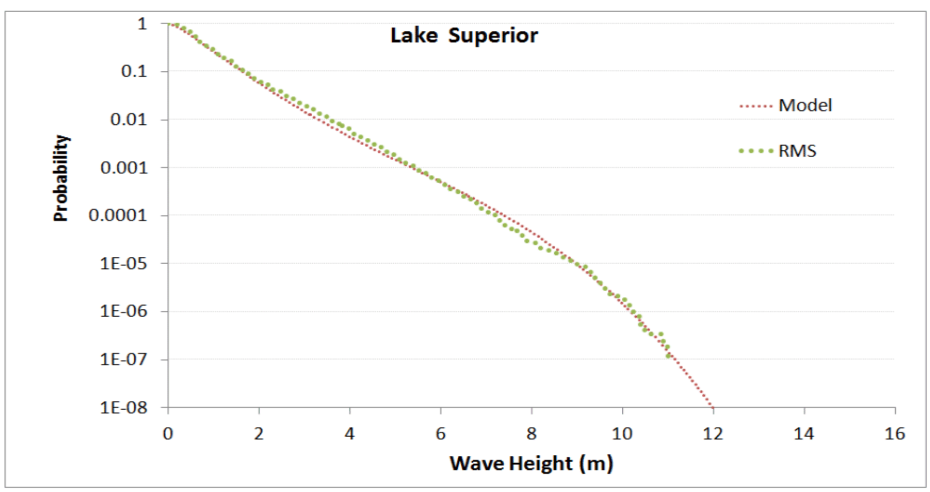
WMO Sea State Code	Wave Height (meters)	Probability	Characteristics
0	0	0	Calm (glassy)
1	0 to 0.1	0.7	Calm (rippled)
2	0.1 to 0.5	6.8	Smooth (wavelets)
3	0.5 to 1.25	23.7	Slight
4	1.25 to 2.5	27.8	Moderate
5	2.5 to 4	20.64	Rough
6	4 to 6	13.15	Very rough
7	6 to 9	6.05	High
8	9 to 14	1.11	Very high
9	Over 14	.05	Phenomenal

Analysis

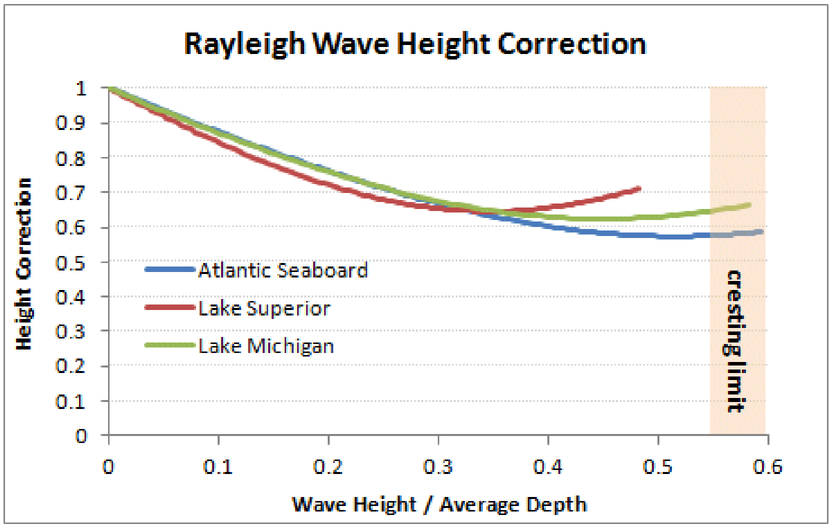
We took a deep analysis of three regions from the Army's wave information data source, the eastern seaboard of the Atlantic coast, along with Lake Michigan and Lake Superior. These all fit a model following a BesselK distribution subject to crest height and ocean depth interactions. (See the white paper on [stochastic modeling])



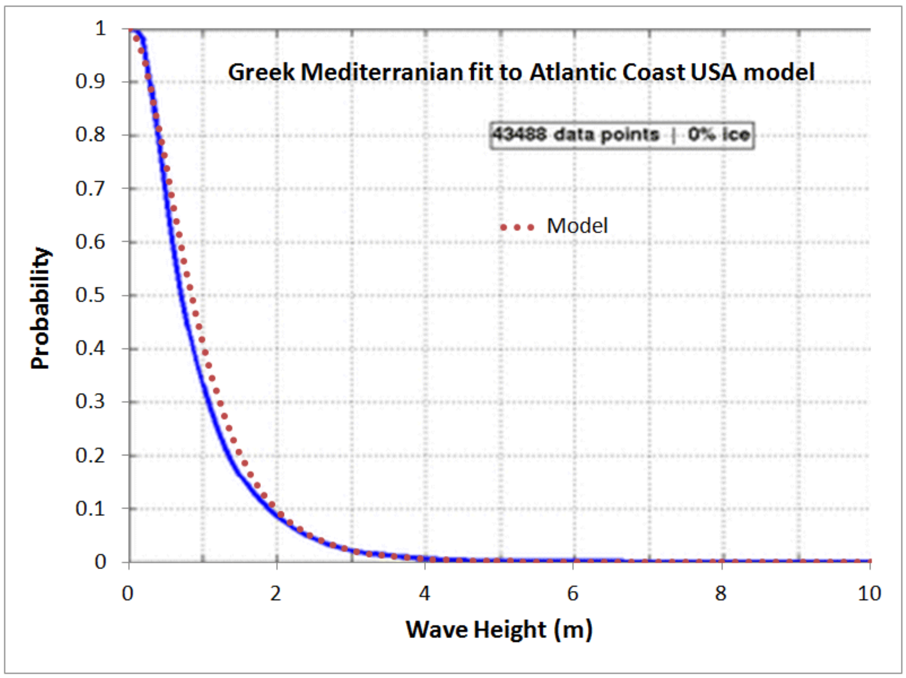




The correction factor appears universal across the regions as plotted below.

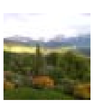


We can thus extrapolate the model to other regions across the earth and find a reasonable fit. The plot below is a fit of sea state distribution off the coast of Greece using the Atlantic seaboard model



[evaluation spreadsheet: atlantic_and_lake_michigan.xlsx]

Labels context



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Wind Energy Statistics

Edit Share Add Tools

2 Added by Pukite, Paul R [BAE Systems], last edited by Pukite, Paul R [BAE Systems] on Sep 11, 2012 (view change)

Intro

The foundation for this work is described in the Probability Elements white paper.

Data Sources

- Bonneville Power Administration
  This contains several sites spread around Oregon and Washington state.
- Ontario IESO
  Hourly wind generator output spreadsheet, latest :
  http://www.ieso.ca/imoweb/pubs/marketReports/download/HourlyWindFarmGen_20120615.csv
  Historical CSV file, 04/30/2010
- German Wind Farm Data
  Hourly data which substantiates the Ontario set, spreadsheet

Labels context

Write a comment…