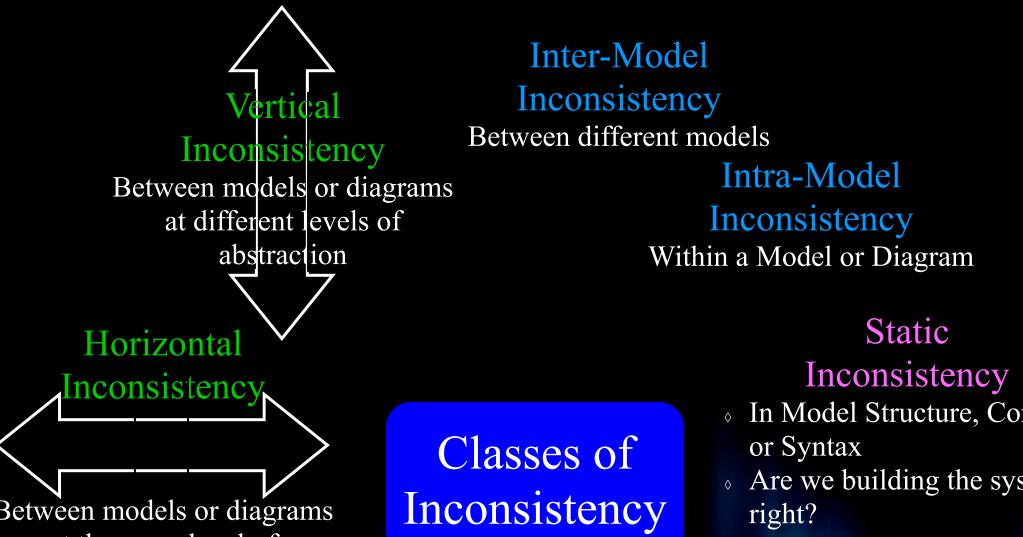
UNL MODEL CONSISTENCY CHECKING

Inconsistencies within UML models or between UML models and requirements, standards, or other design artifacts may result directly in software de-IN / I for or otio



Horizontal Intra-Model Inconsistencies

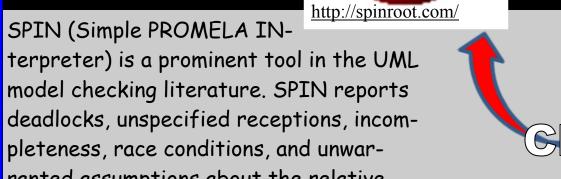
fects. IV&V capability for system				Class diagram(C)				
help prevent these defects. Audit and evaluation of inconsistencies may also provide clues to other deficiencies in model correctness or completeness.				1) Class of (S) and		Source: Management and verification of the consistency among UML Models, Atsushi Ohnishi (Department of Computer Science, Ritsumeikan University, Shiga		
This poster was developed through a NASA IV&V Summer College Intern-				classes in (C) 2) confirmation of classes		Atsushi Ohnishi (Departm 525-8577, Japan)	ent of Computer Science, Rit	sumeikan University, Shiga
ship Program (SCIP) project. It presents classes of UML model inconsis-			State chart	without state charts. 3) Attributes defining				
tency, examples of UML model inconsistency, approaches to identifying in-			(S)	states in (S) and attributes in (C)				
consistency, and some consistency checking tools of interest.				 Range of attribute values in (C) and (S) 				
\wedge				5) actions, activities in (S) and methods in (C)	State chart(S)	Ι	Tyomploy	r of
Inter-Model			1) Objects in (Q) and classes in (C)	 Object in (Q) and class of (S) 		Example		
		Sequence	 Messages between objects in (Q) and 	 Messages in (Q) and actions, activities in 		nconsiste	ency	
Between different models			chart(Q)	associations between coressponding classes in (C)	(S)			
Inconsistency Between models or diag		Intra-Model		 Messages in (Q) and methods in (C) 		Sequence chart(Q)		
at different levels of		Inconsistency		 Objects in (L) and classes in (C) 	 Objects in (L) and class of (S) 	 0bjects in (L) and in (Q) 		
abstraction	Witl	hin a Model or Diagram	Collaboration	 Messages between objects in (L) and associations between 	 Messages in (L) and actions, activities in 	 Messages in (L) and in (Q) 		
			diagram(L)	corresponding classes in (C)	(S)	for directions, sequence, source,		
Horizontal		Static		 Messages in (L) and method in (C) 		and destination	Collaboration	
Inconsistency		Inconsistency					diagram(L)	
		 In Model Structure, Content 		 Actors in (U) and classes in (C) 	 Actors in (U) and class of (S) 	 Actors in (U) and objects in (Q) 	 Actors in (U) and objects in (L) 	
	Classes of	or SyntaxAre we building the system	Use case diagram(U)	 Use cases in (U) and methods in (C) 		2)use cases in (U) and messages in	2) Use cases in (U) and messages	
Between models or diagrams	Inconsistency	right?			(S)	(Q)	in (L)	Use case diagram(U)
at the same level of		Dynamic		1) Classes in (A) and in	1) Classes in (A) and class of (S)	 Classes in (A) and objects in (Q) 	 Classes in (A) and objects in (Q) 	1) Classes in (A) and actores in (U)
abstraction		Inconsistency		 Actions in (A) and methods in (C) 	 Actions in (A) and actions, activities in 	2) Actions in (A)	 Actions in (A) and messages in 	 Actions in (A) and use cases in (U)
			Activity diagram(A)	3) Control flows between	(S)	and messages in (Q)	(L)	
Launch		pected behavior		classes in (A) and associations in (C)		 Control flows between classes in (A) and messages 	 Control flows between classes in (A) and message 	
Eddireri						in (Q)	in (L)	
	Semantic	• Are we building the right				T		
Lift Off Deploy Separate		Are we building the right system?	Figure 1	Knowledge-based verific	ation items among UM	L models	A DESCRIPTION OF THE R.	
Lift Off Deploy Separate			Figure 1	Knowledge-based verific	ation items among UM	L models		
Lift Off Deploy Separate			Figure 1	Knowledge-based verific	ation items among UM	L models		
Lift Off Deploy Separate Diff	iconsistency ferent Meanings		Figure 1	Knowledge-based verific Approach	Advantaş	ges	Disadvant	<u> </u>
Lift Off Deploy Separate Diff	iconsistency ferent Meanings	system? Syntactic nconsistency n Model and Language	Figure 1			ges 51 St se	trict commitment t mantics	o the chosen
Lift Off Deploy Separate Diff	ferent Meanings	system? Syntactic by the system of the sys	Figure 1	Approach	Advantag Natural extension to language Enhanced meta-lan	geso theStguageNconstraintsus	trict commitment t mantics on-trivial impleme sually needs acces	entation and ss to some
Lift Off Deploy Separate Diff	savings Account' spaces are not allowed in elements of kind 'Classical and the spaces are not allowed in elements of kind 'C	system? Syntactic source of the system of	Figure 1	Approach Meta-Modeling Constraint Language	Advantag Natural extension to language Enhanced meta-lan allowing for better Ease of check const	geso theSto theStguageNconstraintsusunistency andC	trict commitment to mantics on-trivial impleme sually needs access navailable meta-mould be inefficient	entation and ss to some odel data (not
Lift Off Deploy Separate Diff	Source of the second se	system? Syntactic source of the system of	Figure 1	Approach Meta-Modeling	Advantag Natural extension to language Enhanced meta-lan allowing for better	geso theStguageNconstraintsusunistency andCistencysc	trict commitment t emantics on-trivial impleme sually needs acces navailable meta-m	entation and ss to some odel data (not ent and
Lift Off Deploy Separate Diff	Source of the second se	system? Syntactic by by b	rms	Approach Meta-Modeling Constraint Language Formal Notations	Advantage Natural extension to language Enhanced meta-lan allowing for better Ease of check constavailability of constavailability of constavailability of constavailability	geso theSto theStguageNconstraintsusununistency andConstraintsistencyscworksdiDealing with UML 1	trict commitment to mantics on-trivial impleme sually needs access navailable meta-m ould be inefficient calable) to implem fficult to integrate	entation and entation and ss to some odel data (not ent and with tools
Lift Off Deploy Separate Diff	Source of the second se	system? Syntactic sconsistency ndodel and Language Rules Mocole Transfor Appro	rms baches	Approach Meta-Modeling Constraint Language Formal Notations	Advantage Natural extension to language Enhanced meta-lan allowing for better Ease of check constant availability of constant frame ble 2: Approached for D	ges standard stand	trict commitment t emantics on-trivial impleme sually needs access navailable meta-m ould be inefficient calable) to implem fficult to integrate	entation and entation and ss to some odel data (not ent and with tools
Lift off Plight System Mated Separated Deployed	Consistency ferent Meanings Betwee Savings Account Savings	system? Syntactic by by b	rms baches	Approach Meta-Modeling Constraint Language Formal Notations	Advantage Natural extension to language Enhanced meta-lan allowing for better Ease of check const availability of const management frame	ges standard stand	trict commitment to mantics on-trivial impleme sually needs access havailable meta-m ould be inefficient calable) to implem fficult to integrate Inconsistency e: An Overview of UML Cons	entation and entation and ss to some odel data (not ent and with tools
Lift Off Deploy Separate Flight System Mated Separated Deployed	Consistency ferent Meanings Betwee Savings Account Savings	system? Syntactic scossistency n Model and Language Rules Model Transfor Language Model Transfor Language	oaches aches	Approach Meta-Modeling Constraint Language Formal Notations	Advantag Natural extension to language Enhanced meta- lan allowing for better Ease of check const availability of const management frame ble 2: Approached for D OCCED AUC	ges standard stand	trict commitment to mantics on-trivial impleme sually needs access havailable meta-m ould be inefficient calable) to implem fficult to integrate Inconsistency e: An Overview of UML Cons	entation and entation and ss to some odel data (not ent and with tools
Lift Off Deploy Separate Flight System Mated Separated Deployed	Consistency ferent Meanings	system? Syntactic scossistency n Model and Language Rules Model Transfor Language Model Transfor Language	oaches aches	Approach Meta-Modeling Constraint Language Formal Notations	Advantag Natural extension to language Enhanced meta- lan allowing for better Ease of check const availability of const management frame ble 2: Approached for D OCCED AUC	ges standard stand	trict commitment to mantics on-trivial impleme sually needs access havailable meta-m ould be inefficient calable) to implem fficult to integrate Inconsistency e: An Overview of UML Cons	entation and entation and ss to some odel data (not ent and with tools
Lift Off Deploy Separate Flight System Image: separate Performance	Consistency ferent Meanings	system? Syntactic scossistency n Model and Language Rules Model Transfor Language Model Transfor Language	oaches aches	Approach Meta-Modeling Constraint Language Formal Notations	Advantag Natural extension to language Enhanced meta- lan allowing for better Ease of check const availability of const management frame ble 2: Approached for D OCCED AUC	ges standard stand	trict commitment to mantics on-trivial impleme sually needs access havailable meta-m ould be inefficient calable) to implem fficult to integrate Inconsistency e: An Overview of UML Cons	entation and entation and ss to some odel data (not ent and with tools
Lift Off Deploy Separate Flight System Image: separate Deployed	Consistency ferent Meanings	system? Syntactic scossistency n Model and Language Rules Model Transfor Language Model Transfor Language	oaches aches	Approach Meta-Modeling Constraint Language Formal Notations	Advantag Natural extension to language Enhanced meta- lan allowing for better Ease of check const availability of const management frame ble 2: Approached for D OCCED AUC	ges standard stand	trict commitment to mantics on-trivial impleme sually needs access havailable meta-m ould be inefficient calable) to implem fficult to integrate Inconsistency e: An Overview of UML Cons	entation and entation and ss to some odel data (not ent and with tools
		system? Syntactic scossistency n Model and Language Rules Model Transfor Language Model Transfor Language	oaches aches	Approach Meta-Modeling Constraint Language Formal Notations	Advantag Natural extension to language Enhanced meta- lan allowing for better Ease of check const availability of const management frame ble 2: Approached for D OCCEPACIC	ges State o the State guage N guage N constraints us istency and C istency sc works di Dealing with UML Source M. Els	trict commitment to mantics on-trivial impleme sually needs access havailable meta-m ould be inefficient calable) to implem fficult to integrate Inconsistency e: An Overview of UML Cons	entation and entation and ss to some odel data (not ent and with tools
	Some is the animality of the animality o	system? Syntactic scossistency n Model and Language Rules Model Transfor Language Model Transfor Language	oaches aches	Approach Meta-Modeling Constraint Language Formal Notations	Advantag Natural extension to language Enhanced meta- lan allowing for better Ease of check const availability of const management frame ble 2: Approached for D OCCED AUC	ges State o the State guage N guage N constraints us istency and C istency sc works di Dealing with UML Source M. Els	trict commitment to mantics on-trivial impleme sually needs access havailable meta-m ould be inefficient calable) to implem fficult to integrate Inconsistency e: An Overview of UML Cons	entation and entation and ss to some odel data (not ent and with tools
	<complex-block></complex-block>	system? Symactic acconsistency ntodel and Language Rules Model Decorrections Appending Control of the system Appending Control of the system Control o	oaches aches	Approach Meta-Modeling Constraint Language Formal Notations	Advantag Natural extension to language Enhanced meta- lan allowing for better Ease of check const availability of const management frame ble 2: Approached for D OCCEPACIC	ges State o the State guage N guage N constraints us istency and C istency sc works di Dealing with UML Source M. Els	trict commitment to mantics on-trivial impleme sually needs access havailable meta-m ould be inefficient calable) to implem fficult to integrate Inconsistency e: An Overview of UML Cons	entation and entation and ss to some odel data (not ent and with tools
Lift off Flight System Image: Comparison of the separated of the polyced of the separated of the polyced of the separated of the polyced of the separated of the	consistency fecent Meanings	system? Symactic nconsistency n Model and Language Rules Model Transfor Approfinding In Checking tool. s them in a	oaches aches	Approach Meta-Modeling Constraint Language Formal Notations	Advantag Natural extension to language Enhanced meta- lan allowing for better Ease of check const availability of const management frame ble 2: Approached for D OCCEPACIC	ges State guage N guage N constraints us istency and C istency sc works di bealing with UML Source Dealing with UML Source Dealing with UML Source M. Els Source	trict commitment to mantics on-trivial impleme sually needs access havailable meta-m ould be inefficient calable) to implem fficult to integrate Inconsistency e: An Overview of UML Cons	entation and entation and ss to some odel data (not ent and with tools
Lift off Plight System Plight S	<complex-block></complex-block>	system? Syntactic nconsistency n Model and Language Rules Model Transfor Checking tool. s them in a user to select	rms aches aches aches	Approach Meta-Modeling Constraint Language Formal Notations Ta Do Do Do Do Do Do Do Do Do Do Do Do Do	Advantage Natural extension to language Enhanced meta-lan allowing for better Ease of check const availability of const management frame ble 2: Approached for D OCCEDACCO	ges State guage N guage N constraints us istency and C istency and C istency and C istency and C unitstency di cealing with UML Source Dealing with UML Source Market Source	trict commitment to mantics on-trivial impleme sually needs access havailable meta-m ould be inefficient calable) to implem fficult to integrate Inconsistency e: An Overview of UML Cons	entation and entation and ss to some odel data (not ent and with tools
Lift off <th>consistency ferent Meanings</th> <th>system? Syntactic sousistency nodel and Language Rules Model Transfor Language Approximation Statemina e user to select t, and re- in else incom</th> <th>Son Son Son Son Son Son Son Son Son Son</th> <th>Approach Meta-Modeling Constraint Language Formal Notations Ta Distancy Distancy</th> <th>Advantage Natural extension to language Enhanced meta-lan allowing for better Ease of check const availability of const management frame ble 2: Approached for D OCCEDACCO</th> <th>ges State guage N guage N constraints us istency and C istency sc works di bealing with UML Source Dealing with UML Source Dealing with UML Source M. Els Source</th> <th>trict commitment temantics on-trivial implements and a sually needs access navailable meta- meta- meta- ould be inefficient alable) to implement fficult to integrate Inconsistency e: An Overview of UML Constants assar, L. Briand</th> <th>entation and entation and ss to some odel data (not ent and with tools</th>	consistency ferent Meanings	system? Syntactic sousistency nodel and Language Rules Model Transfor Language Approximation Statemina e user to select t, and re- in else incom	Son	Approach Meta-Modeling Constraint Language Formal Notations Ta Distancy Distancy	Advantage Natural extension to language Enhanced meta-lan allowing for better Ease of check const availability of const management frame ble 2: Approached for D OCCEDACCO	ges State guage N guage N constraints us istency and C istency sc works di bealing with UML Source Dealing with UML Source Dealing with UML Source M. Els Source	trict commitment temantics on-trivial implements and a sually needs access navailable meta- meta- meta- ould be inefficient alable) to implement fficult to integrate Inconsistency e: An Overview of UML Constants assar, L. Briand	entation and entation and ss to some odel data (not ent and with tools
Lift off <th>consistency ferent Meanings Betwee</th> <th>system? Syntactic nconsistency n Model and Language Rules MODEL Transformer Approx Finding 10 Checking tool. s them in a e user to select t, and re- ing else incon- fects are re-</th> <th>Son Son Son Son Son Son Son Son Son Son</th> <th>Approach Meta-Modeling Constraint Language Formal Notations Ta Distancy Distancy</th> <th>Advantage Natural extension to language Enhanced meta-lan allowing for better Ease of check const availability of const management frame ble 2: Approached for D OCCEDACCO</th> <th>ges State guage N guage N constraints us istency and C istency sc works di bealing with UML Source Dealing with UML Source Dealing with UML Source Market Source Source Source Source Source Source Source Source Source Source Source Source Source</th> <th>trict commitment temantics on-trivial implements and a sually needs access navailable meta- meta- meta- ould be inefficient alable) to implement fficult to integrate Inconsistency e: An Overview of UML Constants assar, L. Briand</th> <th>to the chosen entation and ss to some odel data (not ent and with tools istency Management.</th>	consistency ferent Meanings Betwee	system? Syntactic nconsistency n Model and Language Rules MODEL Transformer Approx Finding 10 Checking tool. s them in a e user to select t, and re- ing else incon- fects are re-	Son	Approach Meta-Modeling Constraint Language Formal Notations Ta Distancy Distancy	Advantage Natural extension to language Enhanced meta-lan allowing for better Ease of check const availability of const management frame ble 2: Approached for D OCCEDACCO	ges State guage N guage N constraints us istency and C istency sc works di bealing with UML Source Dealing with UML Source Dealing with UML Source Market Source Source Source Source Source Source Source Source Source Source Source Source Source	trict commitment temantics on-trivial implements and a sually needs access navailable meta- meta- meta- ould be inefficient alable) to implement fficult to integrate Inconsistency e: An Overview of UML Constants assar, L. Briand	to the chosen entation and ss to some odel data (not ent and with tools istency Management.

checking capability.

🖩 ၈၀ 🖻 🏹 🛤

OCLE provides an environment for formulating OCL rules and for detecting static and dynamic inconsistency at the model self. level of system abstraction. In addition to automating Methodological Rules, Profile Rules or Target Implementation Language Rules expressed in OCL. For example, the OCLE tool can be used to check that object diagrams conform to a class model, i.e., that invariants specified in the class model hold in the object diagrams. Dynamic consistency checking is supported via translation of OCL enhanced UML to Java LOO Messages OCL output Eval source code.

Spin



ranted assumptions about the relative speeds of processes. SPIN uses PROMELA (Process Meta Language) to check models. However, SPIN is not made specifically for UML. Use of SPIN requires translation from UML to a SPIN model. XSPIN could potentially be used to integrate PROMELA and SPIN with Together or other Eclipse-based UML modeling tools for UML model consistency checking.





NASA POC & Presenter: Michael Facemire L-3 Communications Michael.l.Facemire@ivv.nasa.gov

IcerModel Me

http://lci.cs.ubbcluj.ro

Principal Author: Chance B. Cover NASA IV&V Summer College Internship Program (SCIP) NASA Independent Verification and Validation Facility Fairmont, West Virginia

