

It's Your Loss: Classifying Information Loss During Variability Model Roundtrip Transformations











Kevin Feichtinger¹, Chico Sundermann², Thomas Thüm² and Rick Rabiser^{1,3}

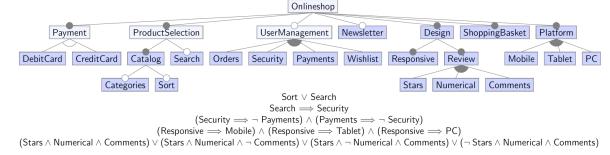
- ¹ LIT Cyber-Physical Systems Lab
- ² University of Ulm
- ³ Christian Doppler Lab VaSiCS







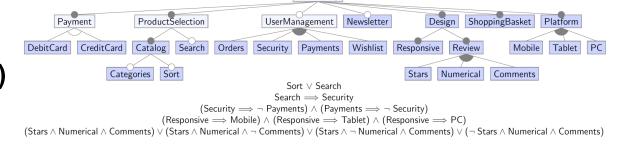
- Feature modeling (FeatureIDE, UVL, Clafer,...)
- Decision modeling (DOPLER, IVML,...)



ID	Question	Туре	Range	Card.	Constraint/Rule	Visibility
Payment	Which payment methods should be supported?	Enum	DebitCard CreditCard	1:1		
					if (Search) { UserManagement = Security }	
Search	Should a search function be supported?	Boolean	true false		if (!Search) { Sort = true }	
Categories	Split products into categories?	Boolean	true false			
Sort	Should products be sortable?	Boolean	true false		if (!Sort) { Search = true }	
					if (Security) { disAllow(Payments) }	
					if (!Security) { allow(Payments) }	
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UserManagement	Which user management options should be added?	Enum	Orders Security Payments Wishlist	1:4	if (!Payments) { allow(Security) }	
Newsletter_percent	How many percent off?	Number	0 - 100			
Newsletter_mail	From which mail should the newsletter be sent?	String				
Review	Which review techiques should be supported	Enum	Stars Numerical Comments	2:3		

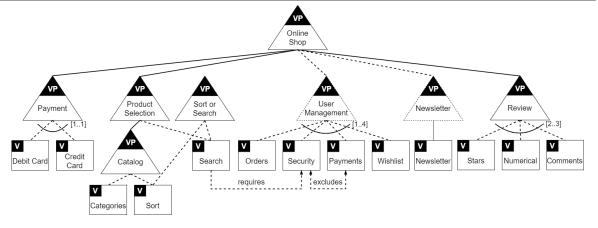


- Feature modeling (FeatureIDE, UVL, Clafer,...)
- Decision modeling (DOPLER, IVML,...)
- Orthogonal Variability modelling (OVM)
- UML-based variability modelling
- Delta-oriented modelling
- Textual variability modeling languages
- Common Variability Language



Onlineshop

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- Kconfig (Linux)
- Component Definition Language (eCos)



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```
menu "Power management and ACPI options"
 depends on !X86_VOYAGER
  config PM
   bool "Power Management support"
    depends on !IA64_HP_SIM
    ---help---
        "Power Management" means that ...
  config PM DEBUG
   bool "Power Management Debug Support"
    depends on PM
  config CPU IDLE
   bool "CPU idle PM support"
   default ACPI
  config PM SLEEP
   bool
    depends on SUSPEND || HIBERNATION ||
               XEN SAVE RESTORE
   default v
endmenu
```

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- Common Varia
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How can we support researchers and practitioners in picking the right approach for their specific use case?

the strengths and weaknesses of an approach?

Question

Component Definition Language (eCos)



Onlineshop

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config CPU_IDLE
bool "CPU idle PM support"
default ACPI
config PM_SLEEP
bool
depends on SUSPEND || HIBERNATION ||
XEN_SAVE_RESTORE
default y
...

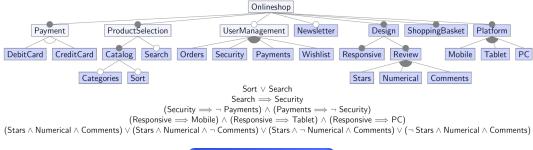
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Card. Constraint/Rule

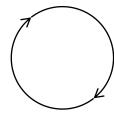
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Visibility









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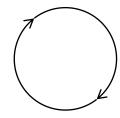












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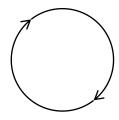






(1) Switching to a different approach without losing invested modeling efforts





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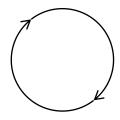






- (1) Switching to a different approach without losing invested modeling efforts
- (2) Experimenting with different approaches before selecting one





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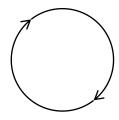






- (1) Switching to a different approach without losing invested modeling efforts
- (2) Experimenting with different approaches before selecting one
- (3) Integrating tools of other approaches, e.g., for analysis





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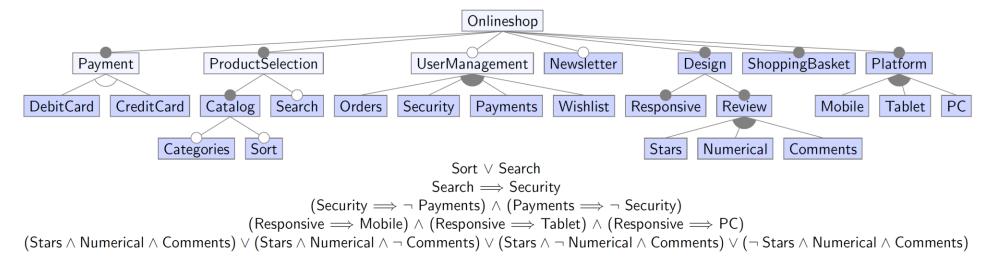


- (1) Switching to a different approach without losing invested modeling efforts
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Semantic and expressiveness differences cause information loss, potentially allowing the configuration of broken/invalid products!

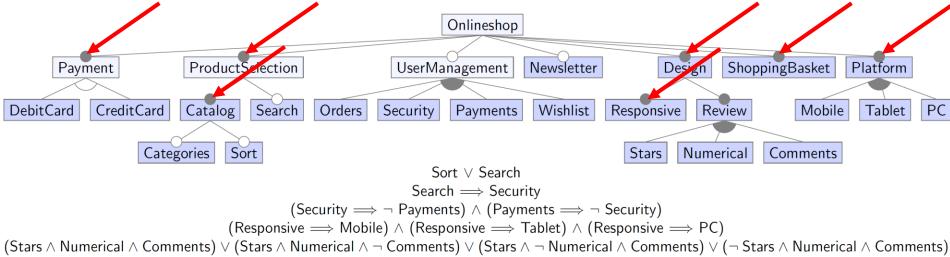


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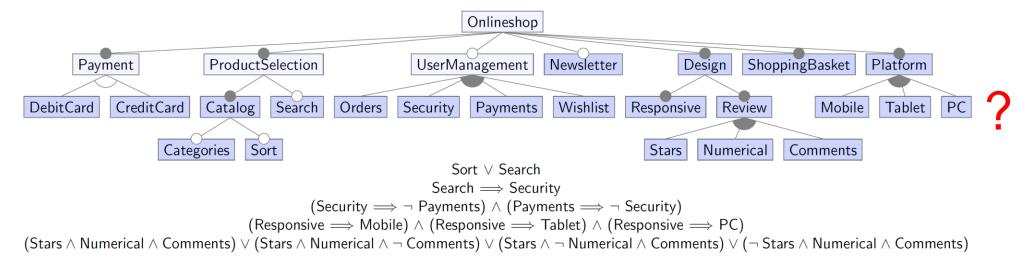
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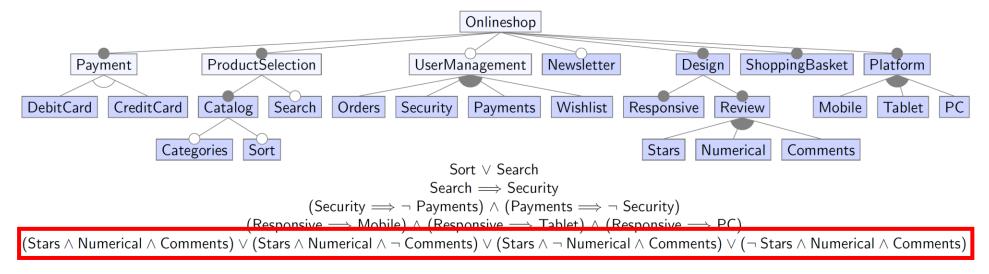
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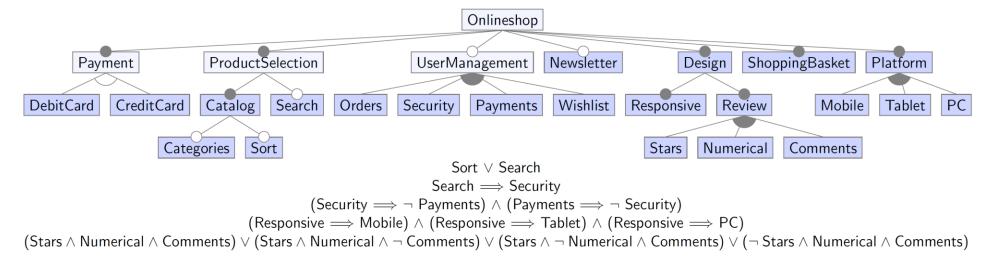




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Search	Shoul Information loss currently is simply accepted during = Security }						
Categories	transformation, without further investigation!						
Sort	Should	,, w	illiout fulfiller lilves	Stif	Jationi		
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• Built of mapping tables between 4 approaches







Identified 4 information loss classes

- Built of mapping tables between 4 approaches
- Identified 4 information loss classes



Entity or relationship can be transformed 1:1











• Built of mapping tables between 4 approaches







Identified 4 information loss classes

no information loss

Entity or relationship can be transformed 1:1



structural loss

No identical transformation back possible









Identified 4 information loss classes

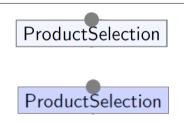
no information loss

Entity or relationship can be transformed 1:1



semantic loss

Entity or relationship loses properties



structural loss

No identical transformation back possible

• Built of mapping tables between 4 approaches







Identified 4 information loss classes

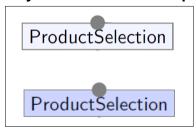
no information loss

Entity or relationship can be transformed 1:1



semantic loss

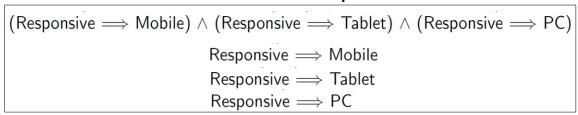
Entity or relationship loses properties





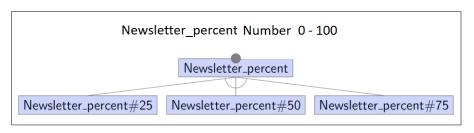
structural loss

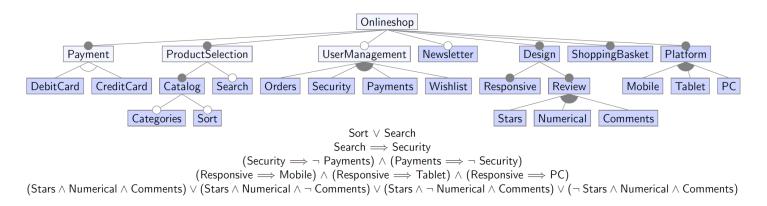
No identical transformation back possible



configurability loss

Entity or relationship cannot be transformed in full capacity



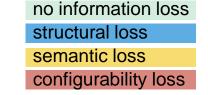


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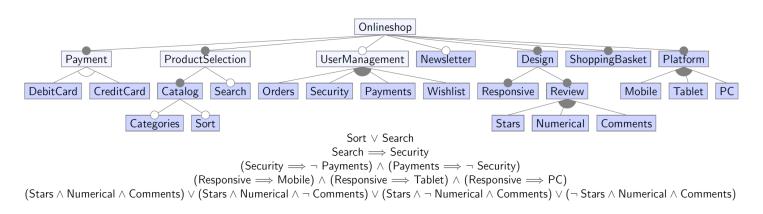
[1] Deepak Dhungana, Paul Grünbacher, and Rick Rabiser. 2011. The DOPLER Meta-Tool for Decision-Oriented Variability Modeling: A Multiple Case Study. Automated Software Engineering 18, 1 (2011), 77–114.

[2] Chico Sundermann, Kevin Feichtinger, Dominik Engelhardt, Rick Rabiser, and Thomas Thüm. 2021. Yet another textual variability language? a community effort towards a unified language. In Proceedings of the 25th ACM International Systems and Software Product Line Conference - Volume A (SPLC '21). ACM, New York, NY, USA, 136–147.





UV	L Feature Model	DOPLER Decision Model	Roundtrip
Model	imports	not supported	-
Model	namespaces	not supported	-



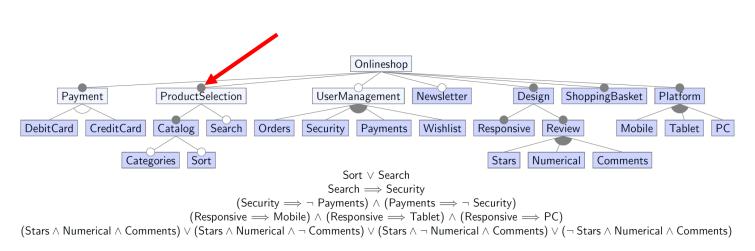
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no information loss
structural loss
semantic loss
configurability loss



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UV	L Feature Model	DOPLER Decision Model	Roundtrip
Model	imports	not supported	-
namespaces	not supported	-	
	Mandatory	Boolean decision	Mandatory Feature
Feature	Mandatory	with visiblity condtion	Manuatory reature
reature	Optional	Boolean decision	Optional Feature
Properties	Abstract	not supported	-
rroperties	Hidden	not supported	-
	String	not supported	-
Attributes	Numeric	not supported	-
	Vector	not supported	-

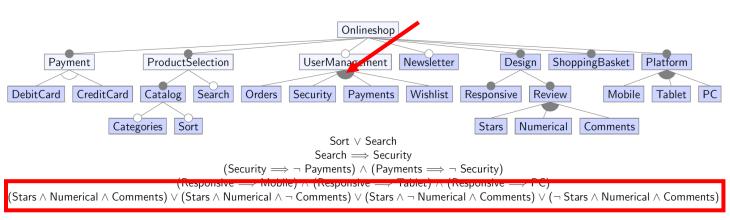
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no information loss
structural loss
semantic loss
configurability loss

15.09.2022



			sponsive rabiet) // (Nespons			
(Stars ∧ Numeri	cal \land Comments) \lor (Stars \land Numerical $\land \lnot$	Comm	ents) \vee (Stars $\wedge \neg$ Numerical \wedge Co	omm	ents) \lor (\lnot Stars \land Numerical \land Com	nments)
ID	Question	Туре	Range	Card	. Constraint/Rule	Visibility
Payment	Which payment methods should be supported?	Enum	DebitCard CreditCard	1:1		
					if (Search) { UserManagement = Security }	
Search	Should a search function be supported?	Boolean	true false		if (!Search) { Sort = true }	
Categories	Split products into categories?	Boolean	true false			
Sort	Should products be sortable?	Boolean	true false		if (!Sort) { Search = true }	
					if (Security) { disAllow(Payments) }	
					if (!Security) { allow(Payments) }	
					if (Payments) disAllow(Security) }	
UserManagement	Which user management options should be added?	Enum	Orders Security Payments Wishlist	1:4	if (!Paym_nts) { allow(Security) }	
Newsletter_percent	How many percent off?	Number	0 - 100			
Newsletter_mail	From which mail should the newsletter be sent?	String				
Review	Which review techiques should be supported	Enum	Stars Numerical Comments	2:3		

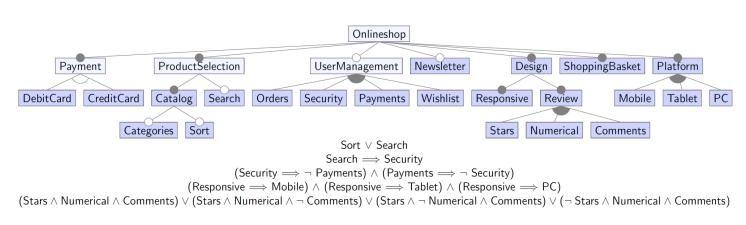
UVI	. Feature Model	DOPLER Decision Model	Roundtrip
Model	imports namespaces	not supported not supported	-
Feature	Mandatory	Boolean decision with visiblity condtion	Mandatory Feature
reature	Optional	Boolean decision	Optional Feature
Properties	Abstract Hidden	not supported not supported	-
	String	not supported	-
Attributes	Numeric	not supported	-
	Vector	not supported	-
	Or	Enumeration decision with cardinality 1:n	Or
C	Alternative	Enumeration decision with cardinality 1:1	Alternative
Group	Group Cardinality (n:m)	Enumeration decision with cardinality n:m	Group Cardinality (n:m)
	Not	Deselect Rule	Not
	And	requires rules	And
Constraints	Or	Visibilitiy conditions requires/excludes rules	Or
	Requires	requires rule	Requires
	Equivalence	two requires rules	Equivalence

[1] Deepak Dhungana, Paul Grünbacher, and Rick Rabiser. 2011. The DOPLER Meta-Tool for Decision-Oriented Variability Modeling: A Multiple Case Study. Automated Software Engineering 18, 1 (2011), 77–114.

[2] Chico Sundermann, Kevin Feichtinger, Dominik Engelhardt, Rick Rabiser, and Thomas Thüm. 2021. Yet another textual variability language? a community effort towards a unified language. In Proceedings of the 25th ACM International Systems and Software Product Line Conference - Volume A (SPLC '21). ACM, New York, NY, USA, 136–147.



no information loss structural loss semantic loss configurability loss



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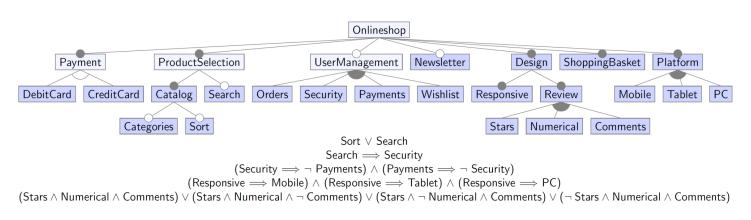
UVI	. Feature Model	DOPLER Decision Model	Roundtrip
Model	imports namespaces	not supported not supported	-
P 4	Mandatory	Boolean decision with visiblity condtion	Mandatory Feature
Feature	Optional	Boolean decision	Optional Feature
Properties	Abstract	not supported	-
rioperties	Hidden	not supported	-
	String	not supported	-
Attributes	Numeric	not supported	-
	Vector	not supported	-
	Or	Enumeration decision	Or
	01	with cardinality 1:n	01
	Alternative	Enumeration decision	Alternative
Group	THE THE THE	with cardinality 1:1	THE THE THE
Croup	Group Cardinality (n:m)	Enumeration decision	Group Cardinality (n:m)
	Not	with cardinality n:m Deselect Rule	Not
	And	requires rules	And
	Allu	1	And
Constraints	Or	Visibilitiy conditions requires/excludes rules	Or
Constraints	Requires	requires rule	Requires
	Equivalence	two requires rules	Equivalence
DOPLE	ER Decision Model	UVL Feature Model	Roundtrip
DOLL	Boolean decision	optional feature	Boolean decision
	Enumeration decision	feature group with cardinality	Enumeration decision
Decision	Number decision	not supported	-
	String decision	not supported	

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UVI	Feature Model	DOPLER Decision Model	Roundtrip
Model	imports	not supported	-
Model	namespaces	not supported	-
	Mandatory	Boolean decision	Mandatory Feature
Feature	Mandatory	with visiblity condtion	Mandatory reature
reature	Optional	Boolean decision	Optional Feature
D	Abstract	not supported	-
Properties	Hidden	not supported	-
	String	not supported	-
Attributes	Numeric	not supported	-
	Vector	not supported	-
		Enumeration decision	0
	Or	with cardinality 1:n	Or
		Enumeration decision	
	Alternative	with cardinality 1:1	Alternative
Group		Enumeration decision	
	Group Cardinality (n:m)	with cardinality n:m	Group Cardinality (n:m
	Not	Deselect Rule	Not
	And	requires rules	And
		Visibilitiy conditions	
Constraints	Or	requires/excludes rules	Or
	Requires	requires rule	Requires
	Equivalence	two requires rules	Equivalence
DOPLI	ER Decision Model	UVL Feature Model	Roundtrip
	Boolean decision	optional feature	Boolean decision
	Enumeration decision	feature group with cardinality	Enumeration decision
Decision	Number decision	not supported	-
	String decision	not supported	_
	IsSelected	constraint literal	IsSelected
	IsTaken	not supported	-
	Not	not literal	Not
	And	and literal	And
	Or	or literal	Or
Expression	Range	not supported	-
	GreaterThen	not supported	_
	LessThen	not supported	_
	Equals	not supported	_
	GreaterEquals	not supported	_
	LessEquals	not supported	_
	Allow	11	Allow
	DisAllow	excludes constraint	DisAllow
	SetValue	not supported	-
Action	GetValue	not supported	
	SetSelected	requires	SetSelected
	DeSelect	excludes	DeSelected

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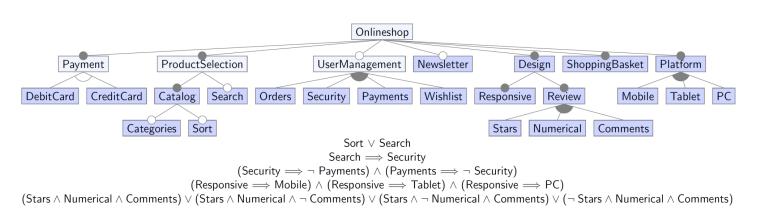


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Newsletter_percen	t How many percent off?	Number	0 - 100			
Newsletter_mail	From which mail should the newsletter be sent?	String				
Review						

DOPLER decision models are more expressive than UVL feature models

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UVI	. Feature Model	DOPLER Decision Model	Roundtrip
Model	imports	not supported	-
Model	namespaces	not supported	-
	Mandatory	Boolean decision	Mandatory Feature
Feature		with visiblity condtion	ŕ
	Optional	Boolean decision	Optional Feature
Properties	Abstract Hidden	not supported not supported	
	String	not supported	
Attributes	Numeric	not supported	_
Tittibutes	Vector	not supported	_
	0	Enumeration decision	
	Or	with cardinality 1:n	Or
	Alternative	Enumeration decision	Alternative
Crown	Alternative	with cardinality 1:1	Alternative
Group	Group Cardinality (n:m)	Enumeration decision	Group Cardinality (n:m)
	1 , , ,	with cardinality n:m	
	Not	Deselect Rule	Not
	And	requires rules	And
Constraints	Or	Visibilitiy conditions requires/excludes rules	Or
Constraints	Di	requires/excludes rules requires rule	Di
	Requires Equivalence	two requires rules	Requires Equivalence
DOPLI	ER Decision Model	UVL Feature Model	Roundtrip
DOLL	Boolean decision	optional feature	Boolean decision
	Enumeration decision	feature group with cardinality	Enumeration decision
Decision	Number decision	not supported	-
	String decision	not supported	-
	IsSelected	constraint literal	IsSelected
	IsTaken	not supported	-
	Not	not literal	Not
	And	and literal	And
	Or	or literal	Or
Expression	Range	not supported	-
	GreaterThen	not supported	-
	LessThen	not supported not supported	-
	Equals GreaterEquals	not supported	-
	LessEquals	not supported	
	Allow	**	Allow
	DisAllow	excludes constraint	DisAllow
	SetValue	not supported	-
Action	GetValue	not supported	-
	SetSelected	requires	SetSelected
	DeSelect	excludes	DeSelected

no information loss

structural loss

semantic loss

configurability loss



RQ. How frequently do the information loss classes happen in transformed variability models?

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RQ. How frequently do the information loss classes happen in transformed variability models?

1) Roundtrip transformed models of varying size and complexity







- 25 FeatureIDE feature models 6 UVL feature models
- 6 DOPLER decision models
- 3 OVM models

RQ. How frequently do the information loss classes happen in transformed variability models?

1) Roundtrip transformed models of varying size and complexity







- 6 UVL feature models
- 6 DOPLER decision models

25 Feature IDE feature models

- 3 OVM models
- 2) Manually inspection of the resulting models



RQ. How frequently do the information loss classes happen in transformed variability models?

1) Roundtrip transformed models of varying size and complexity







- 25 FeatureIDE feature models
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- 6 DOPLER decision models
- 3 OVM models
- 2) Manually inspection of the resulting models
- 3) Verified the observed information losses using the intermediate model

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- 6 UVL feature models
- 6 DOPLER decision models

25 Feature IDE feature models

- 3 OVM models
- 2) Manually inspection of the resulting models
- 3) Verified the observed information losses using the intermediate model
- 4) Classified the losses using the defined information loss classes



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1) Roundtrip transformed models of varying size and complexity







- 25 FeatureIDE feature models
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- 3 OVM models
- 2) Manually inspection of the resulting models
- 3) Verified the observed information losses using the intermediate model
- 4) Classified the losses using the defined information loss classes
- 5) Identified the Roundtrip-Quality of the transformations (identical, equal, loss)

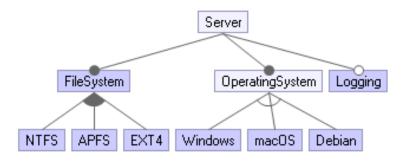


UVL -> DOPLER	#Features	#Constraints	#Decisions	#Rules	#ConfigLoss	#SemLoss	#StrucLoss	R-Qualtiy
automotive02_4	18,616	1,369	19,967	30,591	0	4	451	equal
axTLS	96	14	101	82	0	5	37	equal
Server	10	2	12	12	0	2	0	equal
uClibc	313	56	334	445	0	22	176	equal
uClinux-base	380	3,455	416	1,187	0	0	3,384	equal
uClinux-distribution	1,580	197	1,590	410	0	10	194	equal



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_axTLS	96	14	101	82		5	37	equal
Server	10	2	12	12	0	2	0	equal
uClibc	313	56	334	445	0	22	176	equal
uClinux-base	380	3,455	416	1,187	0	0	3,384	equal
uClinux-distribution	1,580	197	1,590	410	0	10	194	equal



Windows ⇒ NTFS macOS ⇒ APFS



UVL -> DOPLER	#Features	#Constraints	#Decisions	#Rules	#ConfigLoss	#SemLoss	#StrucLoss	R-Qualtiy
automotive02_4	18,616	1,369	19,967	30,591	0	4	451	equal
axTLS	96	14	101	82	0	5	37	equal
Server	10	2	12	12	0	2	0	equal
uClibc	313	56	334	445	0	22	176	equal
uClinux-base	380	3,455	416	1,187	0	0	3,384	equal
uClinux-distribution	1,580	197	1,590	410	0	10	194	equal



UVL -> DOPLER	#Features	#Constraints	#Decisions	#Rules	#ConfigLoss	#SemLoss	#StrucLoss	R-Qualtiy
automotive02_4	18,616	1,369	19,967	30,591	0	4	451	equal
axTLS	96	14	101	82	0	5	37	equal
Server	10	2	12	12	0	2	0	equal
uClibc	313	56	334	445	0	22	176	equal
uClinux-base	380	3,455	416	1,187	0	0	3,384	equal
uClinux-distribution	1,580	197	1,590	410	0	10	194	equal
DOPLER -> UVL	#Decisions	#Rules	#Features	#Constraints	#ConfigLoss	#SemLoss	#StrucLoss	R-Qualtiy
ASEJ1	4	2	109	96	198	0	6	loss
DissModel	11	0	116	0	102	0	10	loss
DOPLERTools	26	7	50	15	16	0	36	loss
eShop	6	7	13	4	0	0	8	equal
TICCODA	I -	^	0.0	0	0	0	33	ognal
HCSSDM	7	0	28	U	U	U	33	equal



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UVL -> DOPLER	#Features	#Constraints	#Decisions	#Rules	#ConfigLoss	#SemLoss	#StrucLoss	R-Qualtiy
automotive02_4	18,616	1,369	19,967	30,591	0	4	451	equal
axTLS	96	14	101	82	0	5	37	equal
Server	10	2	12	12	0	2	0	equal
uClibc	313	56	334	445	0	22	176	equal
uClinux-base	380	3,455	416	1,187	0	0	3,384	equal
uClinux-distribution	1,580	197	1,590	410	0	10	194	equal
DOPLER -> UVL	#Decisions	#Rules	#Features	#Constraints	#ConfigLoss	#SemLoss	#StrucLoss	R-Qualtiy
ASEJ1	4	2	109	96	198	0	6	loss
DissModel	11	0	116	0	102	0	10	loss
DOPLERTools	26	7	50	15	16	0	36	loss
eShop	6	7	13	4	0	0	8	equal
HCSSDM	7	0	28	0	0	0	33	equal
VaMoS	5	1	11	1	0	0	8	equal



UVL -> DOPLER	#Features	#Constraints	#Decisions	#Rules	#ConfigLoss	#SemLoss	#StrucLoss	R-Qualtiy
automotive02_4	18,616	1,369	19,967	30,591	0	4	451	equal
axTLS	96	14	101	82	0	5	37	equal
Server	10	2	12	12	0	2	0	equal
uClibc	313	56	334	445	0	22	176	equal
uClinux-base	380	3,455	416	1,187	0	0	3,384	equal
professional transferred	1 500	107	1 500	410	_	10	104	

The information loss classes can be found in transformed variability models and therefore are applicable to existing variability models

The information loss classes indicate how information is lost during a one-way transformation and a roundtrip transformation

					_			
Tionji	-	_	107	,,,	170	-	-	1000
DissModel	11	0	116	0	102	0	10	loss
DOPLERTools	26	7	50	15	16	0	36	loss
eShop	6	7	13	4	0	0	8	equal
HCSSDM	7	0	28	0	0	0	33	equal
VaMoS	5	1	11	1	0	0	8	equal



 Investigated the information loss occurring between 4 variability modeling approaches

UVI	. Feature Model	DOPLER Decision Model	Roundtrip
Model	imports	not supported	-
	namespaces	not supported	-
	Mandatory	Boolean decision	Mandatory Feature
Feature	· ·	with visiblity condtion Boolean decision	*
	Optional Abstract	not supported	Optional Feature
Properties	Hidden	not supported	-
	String	not supported	
Attributes	Numeric	not supported	
rittributes	Vector	not supported	_
		Enumeration decision	
	Or	with cardinality 1:n	Or
		Enumeration decision	
	Alternative	with cardinality 1:1	Alternative
Group	Construction (Enumeration decision	Current Condition liter (con)
	Group Cardinality (n:m)	with cardinality n:m	Group Cardinality (n:m)
	Not	Deselect Rule	Not
	And	requires rules	And
	Or	Visibility conditions	Or
Constraints		requires/excludes rules	
	Requires	requires rule	Requires
DOBLI	Equivalence ER Decision Model	two requires rules UVL Feature Model	Equivalence
DOPLI	Boolean decision	optional feature	Roundtrip Boolean decision
	Enumeration decision	feature group with cardinality	Enumeration decision
Decision	Number decision	not supported	-
	String decision	not supported	_
	IsSelected	constraint literal	IsSelected
	IsTaken	not supported	-
	Not	not literal	Not
	And	and literal	And
	Or	or literal	Or
Expression	Range	not supported	-
	GreaterThen	not supported	-
	LessThen	not supported	-
	Equals	not supported	-
	GreaterEquals	not supported	-
	LessEquals Allow	not supported	Allow
	DisAllow	excludes constraint	DisAllow
	SetValue	not supported	DISAHOW
Action	GetValue	not supported	
	SetSelected	requires	SetSelected
	DeSelect	excludes	DeSelected
	December	cheraces	Described

no information loss

structural loss

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- Investigated the information loss occurring between
 4 variability modeling approaches
- 4 Information loss classes evaluated using a applicability study

UVL Feature Model		DOPLER Decision Model	Roundtrip
Model	imports	not supported	-
1,100001	namespaces	not supported	-
Feature	Mandatory	Boolean decision with visiblity condtion	Mandatory Feature
	Optional	Boolean decision	Optional Feature
	Abstract	not supported	-
Properties	Hidden	not supported	-
	String	not supported	-
Attributes	Numeric	not supported	-
	Vector	not supported	-
	Or	Enumeration decision	Or
		with cardinality 1:n Enumeration decision	
	Alternative	with cardinality 1:1	Alternative
Group		Enumeration decision	
	Group Cardinality (n:m)	with cardinality n:m	Group Cardinality (n:m)
	Not	Deselect Rule	Not
	And	requires rules	And
	Or	Visibility conditions	Or
Constraints		requires/excludes rules	
	Requires	requires rule two requires rules	Requires
DOPLE	Equivalence ER Decision Model	UVL Feature Model	Equivalence Roundtrip
BOTE	Boolean decision	optional feature	Boolean decision
ъ	Enumeration decision	feature group with cardinality	Enumeration decision
Decision	Number decision	not supported	-
	String decision	not supported	= _ , _ ,
	IsSelected	constraint literal	IsSelected
	IsTaken Not	not supported not literal	Not
	And	and literal	And
	Or	or literal	Or
Expression	Range	not supported	-
	GreaterThen	not supported	-
	LessThen	not supported	-
	Equals	not supported	-
	GreaterEquals	not supported	-
	LessEquals	not supported	-
Action	Allow DisAllow	excludes constraint	Allow DisAllow
	DisAllow SetValue	not supported	DISAHOW
	GetValue	not supported not supported	
	SetSelected	requires	SetSelected
	DeSelect	excludes	DeSelected

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- Investigated the information loss occurring between
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Future Work

Extending to additional variability modeling approaches

UVI	L Feature Model	DOPLER Decision Model	Roundtrip
Model	imports	not supported	-
	namespaces	not supported	-
	Mandatory	Boolean decision with visiblity condtion	Mandatory Feature
Feature	Optional	Boolean decision	Optional Feature
	Abstract	not supported	-
Properties	Hidden	not supported	-
	String	not supported	-
Attributes	Numeric	not supported	-
	Vector	not supported	-
	Or	Enumeration decision	Or
		with cardinality 1:n Enumeration decision	
	Alternative	with cardinality 1:1	Alternative
Group		Enumeration decision	
	Group Cardinality (n:m)	with cardinality n:m	Group Cardinality (n:m)
	Not	Deselect Rule	Not
	And	requires rules	And
	Or	Visibilitiy conditions	Or
Constraints		requires/excludes rules	
	Requires	requires rule	Requires
DODLI	Equivalence ER Decision Model	two requires rules UVL Feature Model	Equivalence Roundtrip
DOLL	Boolean decision	optional feature	Boolean decision
	Enumeration decision	feature group with cardinality	Enumeration decision
Decision	Number decision	not supported	-
	String decision	not supported	- , ,
	IsSelected	constraint literal	IsSelected
	IsTaken	not supported	-
	Not And	not literal and literal	Not And
	Or	or literal	Or
Expression	Range	not supported	-
Expression	GreaterThen	not supported	_
	LessThen	not supported	-
	Equals	not supported	-
	GreaterEquals	not supported	-
	LessEquals	not supported	-
	Allow	excludes constraint	Allow
	DisAllow		DisAllow
Action	SetValue GetValue	not supported	-
	SetSelected	not supported requires	SetSelected
	DeSelect	excludes	DeSelected
	Descriet	Cacado	Describe

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- Investigated the information loss occurring between
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Future Work

- Extending to additional variability modeling approaches
- Performing a usefulness study

UVI	L Feature Model	DOPLER Decision Model	Roundtrip
Model	imports	not supported	-
	namespaces	not supported	-
	Mandatory	Boolean decision with visiblity condtion	Mandatory Feature
Feature	Optional	Boolean decision	Optional Feature
	Abstract	not supported	-
Properties	Hidden	not supported	-
	String	not supported	-
Attributes	Numeric	not supported	-
	Vector	not supported	-
	Or	Enumeration decision	Or
		with cardinality 1:n Enumeration decision	
	Alternative	with cardinality 1:1	Alternative
Group		Enumeration decision	
	Group Cardinality (n:m)	with cardinality n:m	Group Cardinality (n:m)
	Not	Deselect Rule	Not
	And	requires rules	And
	Or	Visibilitiy conditions	Or
Constraints		requires/excludes rules	
	Requires	requires rule	Requires
DODLI	Equivalence ER Decision Model	two requires rules UVL Feature Model	Equivalence Roundtrip
DOLL	Boolean decision	optional feature	Boolean decision
	Enumeration decision	feature group with cardinality	Enumeration decision
Decision	Number decision	not supported	-
	String decision	not supported	- , ,
	IsSelected	constraint literal	IsSelected
	IsTaken	not supported	-
	Not And	not literal and literal	Not And
	Or	or literal	Or
Expression	Range	not supported	-
Expression	GreaterThen	not supported	_
	LessThen	not supported	-
	Equals	not supported	-
	GreaterEquals	not supported	-
	LessEquals	not supported	-
	Allow	excludes constraint	Allow
	DisAllow		DisAllow
Action	SetValue GetValue	not supported	-
	SetSelected	not supported requires	SetSelected
	DeSelect	excludes	DeSelected
	Descriet	Cacado	Describe

no information loss

structural loss

semantic loss

configurability loss

