双方向モデル変換によるソフトウエア開発

Software Development based on Bidirectional Model Transformation

国立情報学研究所：胡振江, 日高宗一郎, 加藤弘之, 浅田和之, ザントオ, ヴォフウプト

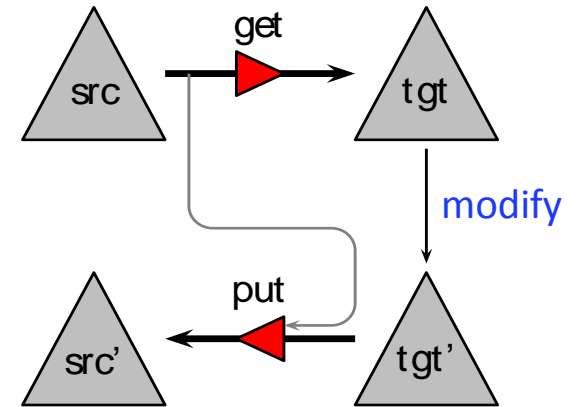電気通信大学：中野圭介   東北大学：松田一孝   北京大学: Hong Mei, Haiyan Zhao

何ができる？

本研究では、双方向変換機構（双方向モデル変換言語と環境）を構築することにより、ソフトウェアの構成手法とソフトウェアの発展手法との関係を科学的に解明し、発展的ソフトウエアを開発するための新しい方法論を確立することを目指す。

現在の研究成果

- モデル変換言語 UnQL+ の提案・実装
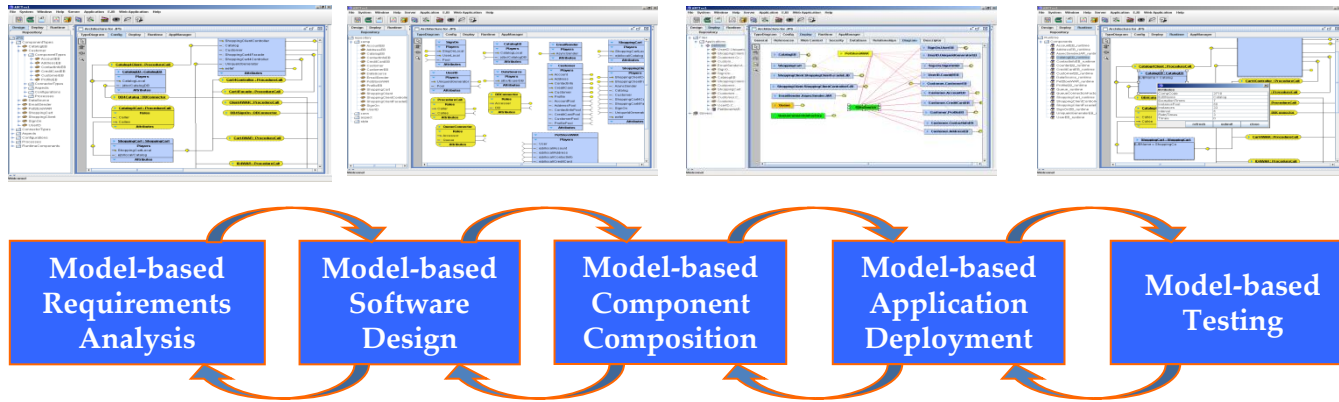- 自動双方向化の枠組（双方向グラフ変換）の定式化、プロトタイプの実装、および応用事例の研究

http://www.biglab.org/

Bidirectional Transformation(BX)

BX on Graphs is Wanted!

Models = Graphs (rather than trees)
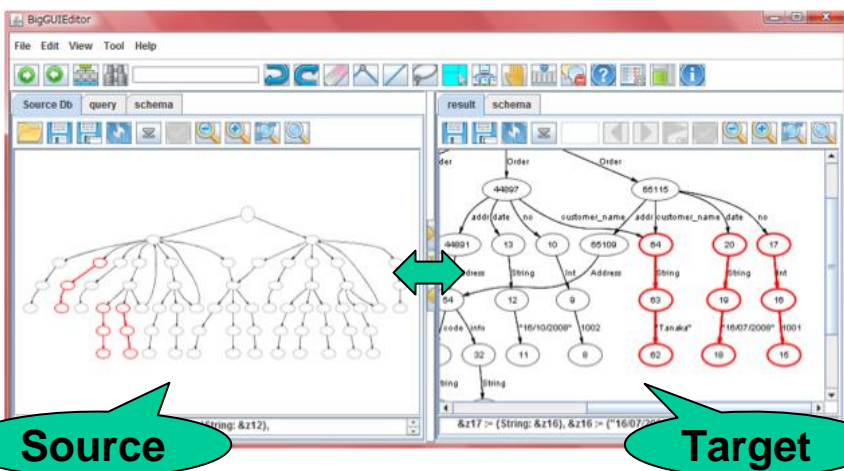Bidirectional Model Transformation = Bidirectional Graph Transformation

- Model-based Requirements Analysis
- Model-based Software Design
- Model-based Component Composition
- Model-based Application Deployment
- Model-based Testing

BiG Challenges

Graphs have node sharing and cycles

- How to deal with termination of graph transformations?
  ➔ Structural Recursion (fold on graphs)
- How to deal with equality of two graphs?
  ➔ Bisimulation (graphs as regular trees)
- How to correctly reflect changes on the view to the source?
  ➔ Traceability based on Bulk Semantics

GRoundTram: A General Functional Framework

- **It is compositional (functional)**
  - Based on the existing graph query language UnQL
- **It is well-behaved**
  - Built upon bidirectional UnCAL: a graph algebra with clear bidirectional semantics
- **It is an integrated development environment**
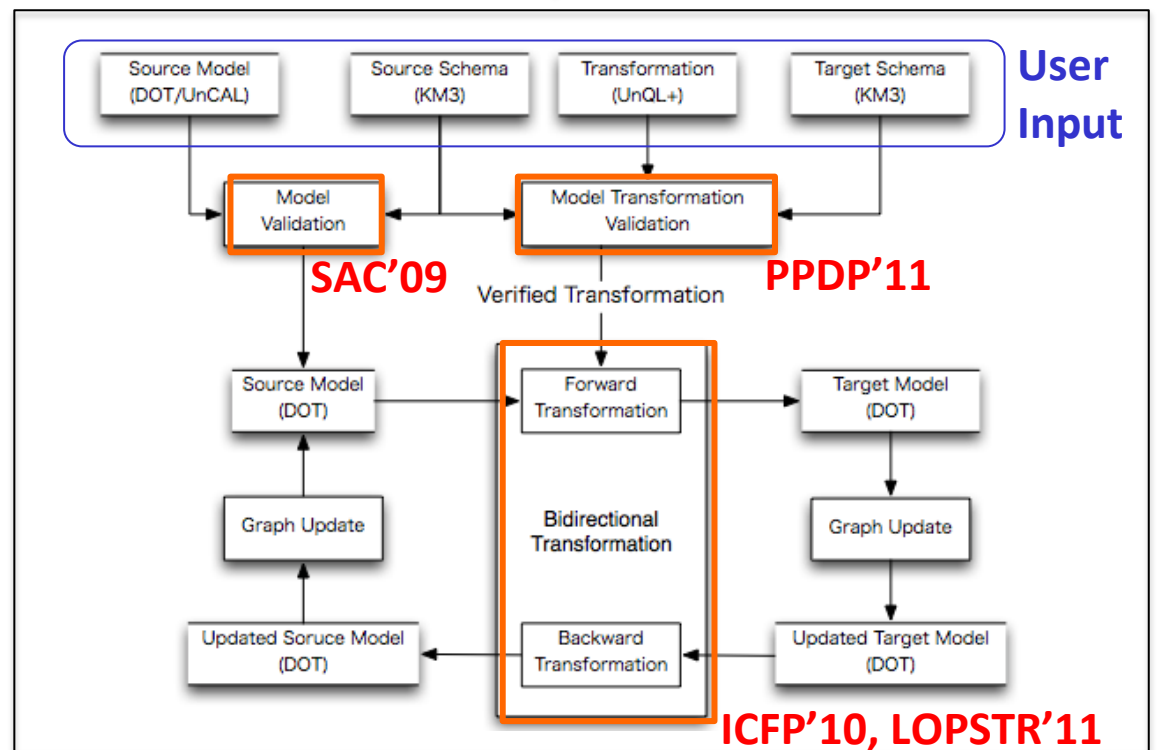 - Graph editor, graph validation, graph transformation checking, visualizations of bidirectional behavior

Source   **Target**

Applications:

Towards automatic Bidirectionalization of ATL	Automatic Feature Model Fixing	Model-Code Co-evolution
(ICMT'11)	(MODELS'10)	(ICSE'12)

Architecture:

SAC'09   PPDP'11

ICFP'10, LOPSTR'11

[1] S. Hidaka, Z. Hu, H. Kato, K. Nakano Towards Compositional Approach to Model Transformations for Software Development, SAC 2009, Mar 2009
[2] S. Hidaka, Z. Hu, K. Inaba, H. Kato, K. Matsuda, K. Nakano Bidirectionalizing Graph Transformations, ICFP 2010, 205-216, Sep 2010
[3] B. Wang, Y. Xiong, Z. Hu, H. Zhao, W. Zhang, H. Mei A Dynamic-Priority based Approach to Fixing Inconsistent Feature Models, Models 2010, 181-195, Oct 2010
[4] I. Sasano, Z. Hu, S. Hidaka, K. Inaba, H. Kato, K. Nakano Toward Bidirectionalization of ATL with GRoundTram, ICMT 2011, 138-151 Jun 2011
[5] S. Hidaka, Z. Hu, K. Inaba, H. Kato, K. Matsuda, K. Nakano and I. Sasano, Marker-directed optimization of UnCAL graph transformations, LOPSTR 2011, 168-182 Jul 2011
[6] K. Inaba, S. Hidaka, Z. Hu, H. Kato, K. Nakano Graph-Transformation Verification using Monadic Second-Order Logic, PPDP 2011, 17-28 Jul 2011
[7] Y. Yu, Y. Lin, Z. Hu, S. Hidaka, H. Kato, L. Montrieux, blinkit: Maintaining Invariant Traceability through Bidirectional Transformations, ICSE 2012, Jun 2012

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contact： Zhenjiang Hu ／ National Institute of Informatics, Professor
TEL : +81-3-4212-2530   FAX : +81-3-3556-1916   Email : hu@nii.ac.jp   WWW : http://research.nii.ac.jp/~hu