

平成 24 年度 航空プログラムグループ公募型研究
(国産旅客機高性能化技術研究開発)

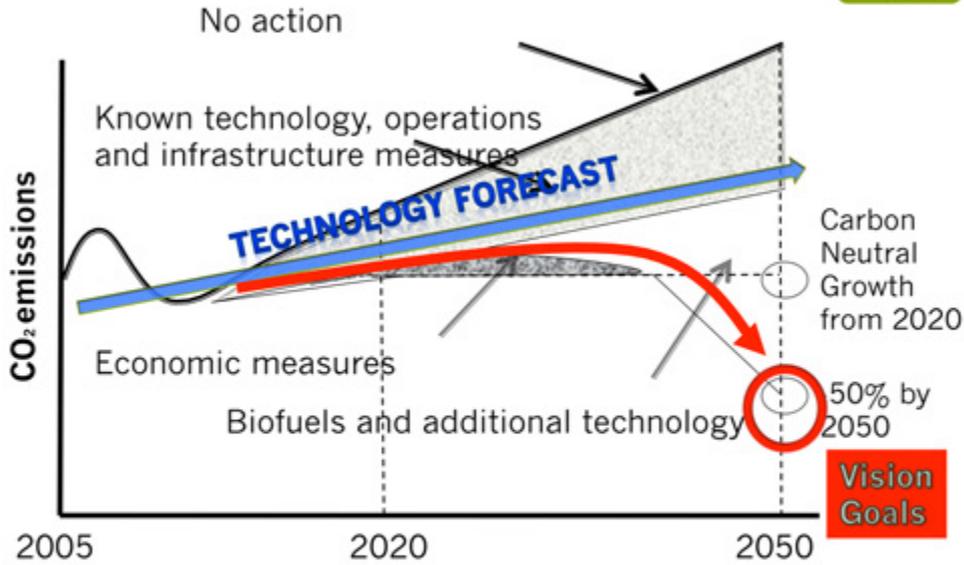


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特任研究員 中村裕子

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- 航空産業技術ロードマップ構築支援の背景
- 昨年度の成果 (日本航空宇宙学会 第43期年会
講演会 若手講演会受賞)
- 本年度の進捗

背景：技術ロードマップ



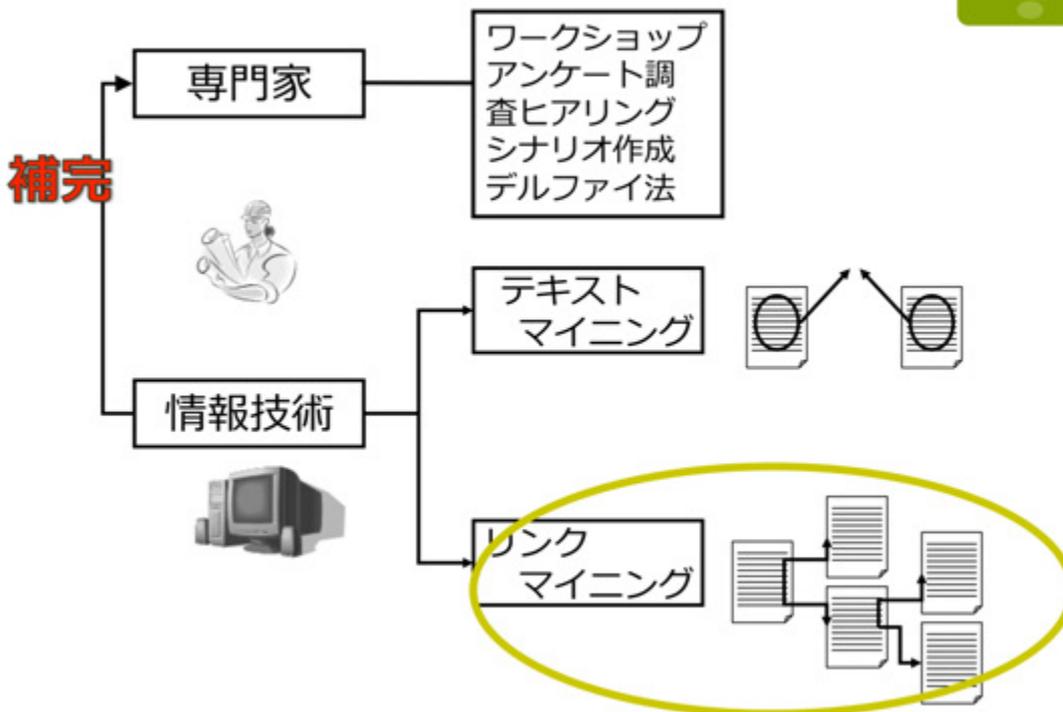
道筋を示し、リソースを集め、ゴールに導くのがロードマップの本質

しかし、ロードマップは生ものである。

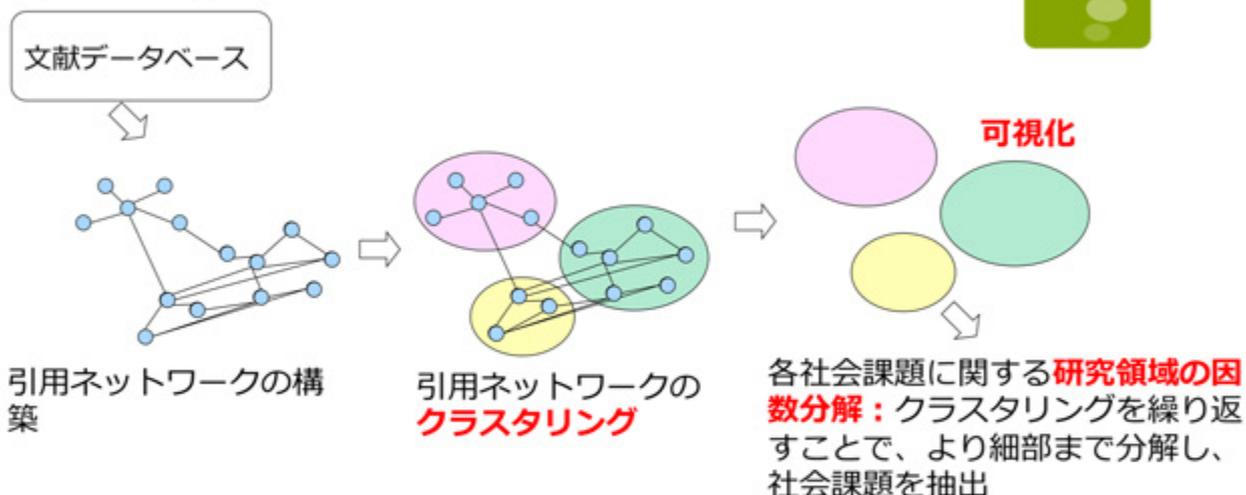
日々変化する環境に対応するため 必要な技術トレンド等の更新



専門家による方法の補完として期待される コンピューターアプローチ



書誌情報をセンサとして用いた社会課題の 抽出に関する研究



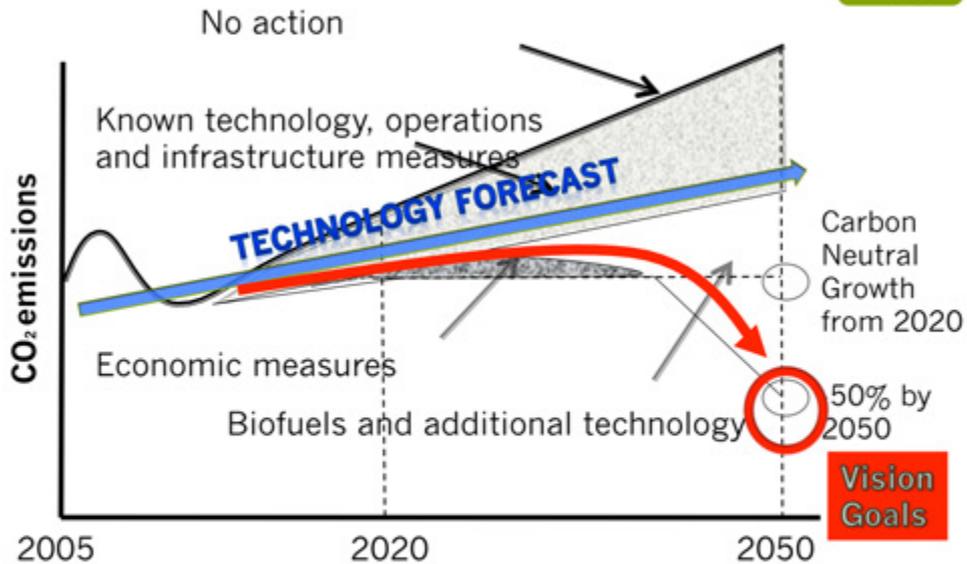
Core technologies

- Corpus cleansing : Shibata et al. *JASIST*, in press.
- Link definition : Shibata et al. *JASIST* (2009)
- Clustering : Newman & Girvan, *Phys. Rev. E* (2004)
- Clustering quality : Takeda & Kajikawa, *Scientometrics* (2010)
- Topological measure : Guimera & Amaral, *Nature* (2005)
- Visualization : Adai et al. *J. Mol. Bio.* (2004)

Applied research

- Boyack et al. *JASIST* (2002)、Börner et al. *ARIST* (2003)、Chen, *JASIST* (2006...)
- 学術論文分析では、トムソン・ロイター社のデータベースを用い論文データを取得

学術俯瞰システムを応用してロードマップ構築支援

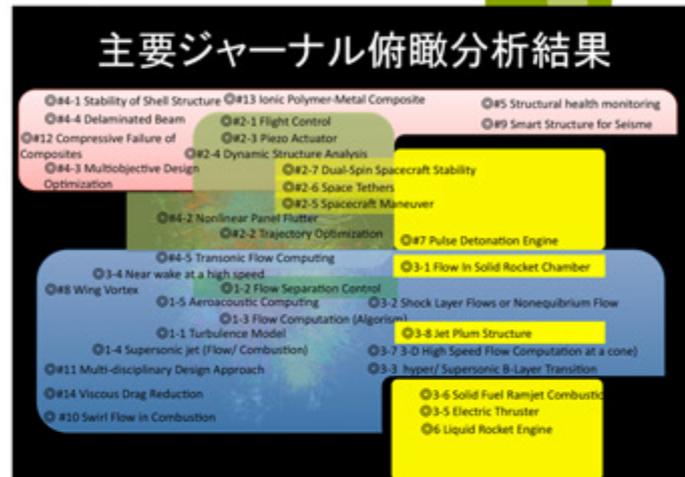
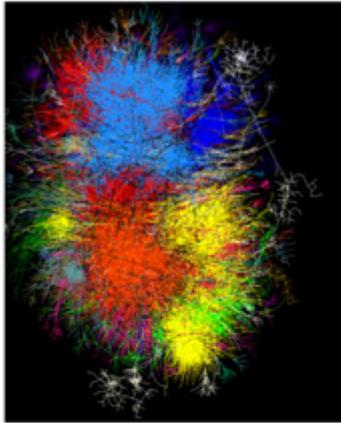


Trend把握、方策検討に貢献したい。

昨年度成果

- リンクマイニングを利用し航空工学主要ジャーナルの分析（ご報告済み）
- 航空工学各分野研究者へのヒアリング

学術俯瞰システムの航空への研究の適用性調査



- 各分野の結果に対するもっともらしさ／違和感
- 本システムの利用場面について
- 望まれる改良点について

JAXA並びにENRIの研究者：構造、エンジン、流体、飛行制御、航空交通管理各分野の方にインタビュー

本年度進捗

- 日本航空宇宙学会 第43期年会講演会 若手講演会受賞
- ヒアリング結果より
 - 航空全体よりも分野をしばった具体的な分析 → 航空管制、複合材材料
 - 学術俯瞰システム改良 → Webシステム化
- 書誌情報分析へ付加価値を（特許を利用した新たな知の統合分野抽出手法研究）

Application and Evaluation of Bibliometrics Methods for the Materials Science and Engineering

- Presented at 2012 INFORMS Annual Meeting in Phoenix, October 14-17
- Shingo Ii (Ogasawara lab.), Nakamura Hiroko**



Introduction

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There are still many problems to be solved.
Joints and adhesives are current hot topics.



Researches for realizing more effective joints and adhesions are being done.

How do I find effective solutions?

- Taking technologies and ideas from other fields would be good.
- Methods used in bibliometrics like data mining are useful.

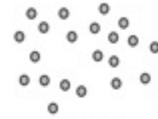
Methodology

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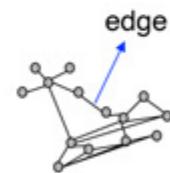
1. Collect the data of papers

- Retrieved word: adhesive
- Base data: 55,425 academic papers from all journals (ISI Web of Science, retrieved at April 2012)



2. Construct citation networks

- System used in this research was developed by Innovation Policy Research Center at the University of Tokyo
- Citation networks were constructed by direct citation



3. Extract maximum connected component

- Maximum connected component consisted of 35,399 papers with 167,896 edges.

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Methodology

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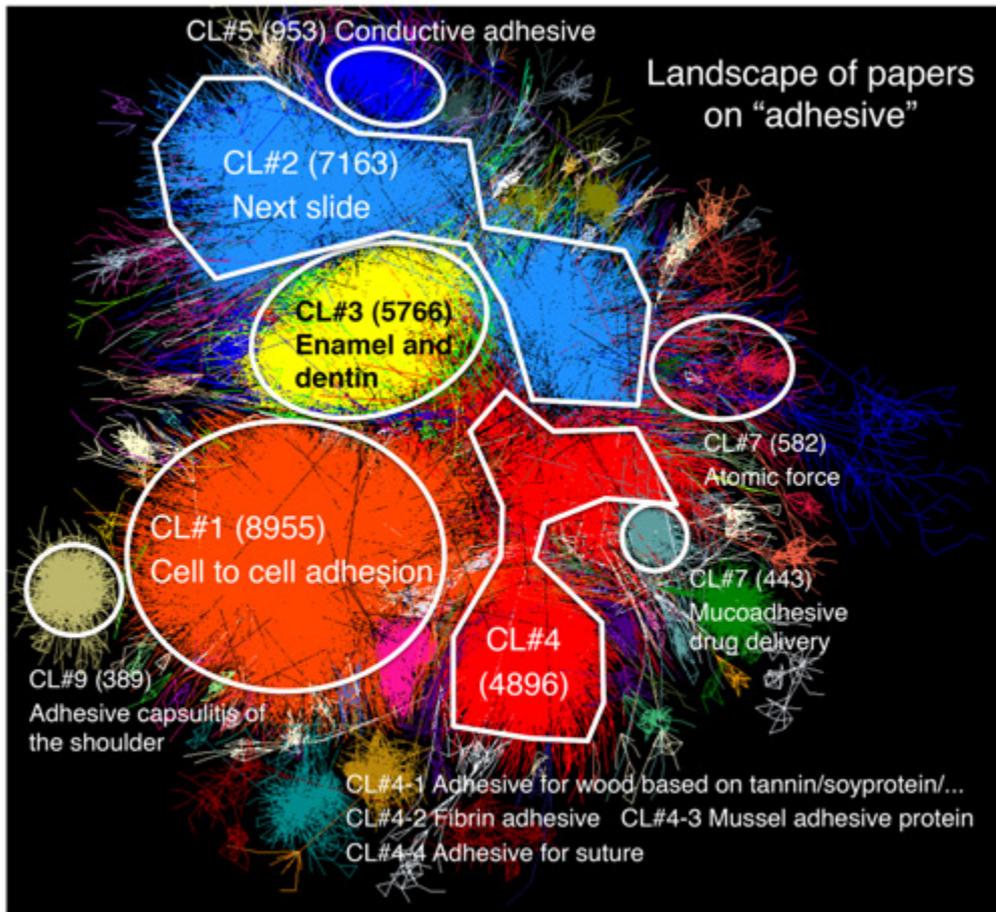


4. Divide the component into clusters

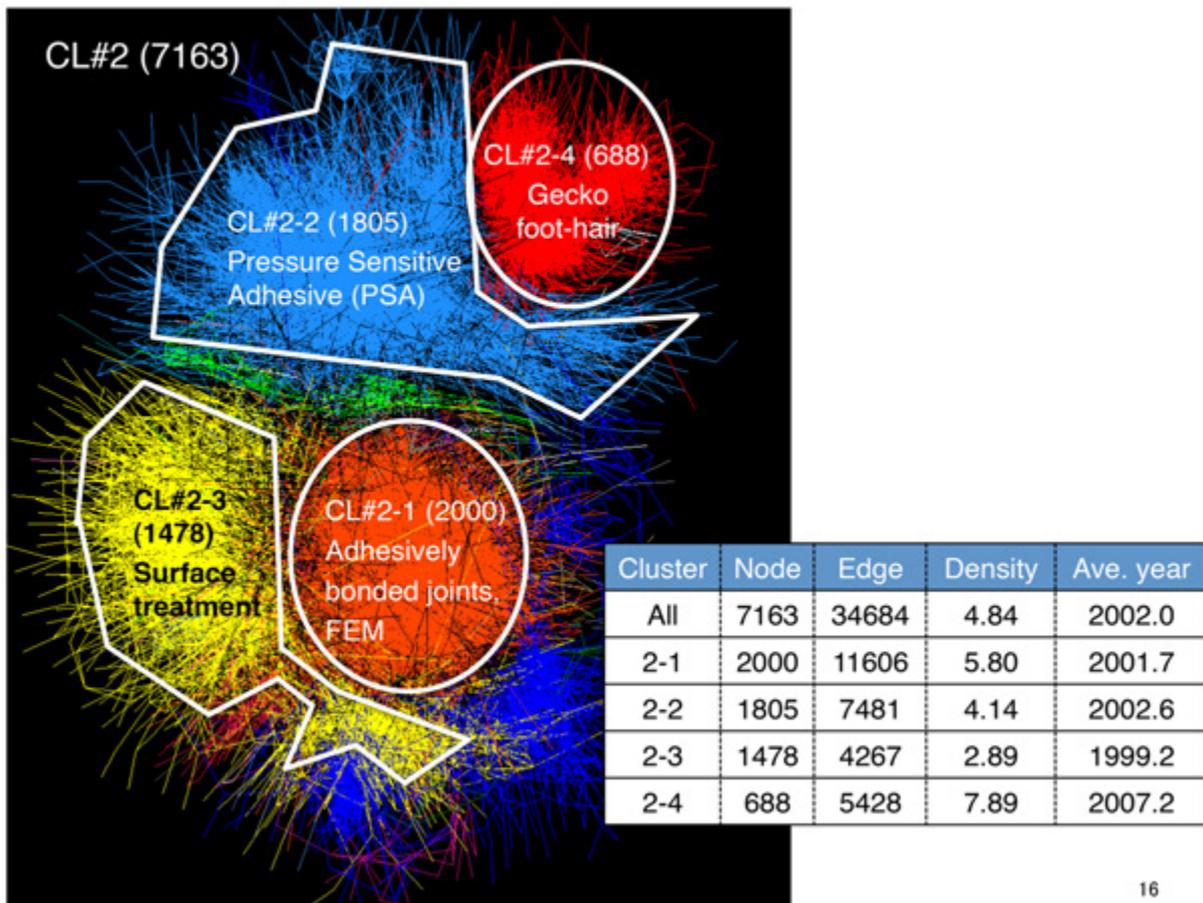
- 239 clusters were created by Newman's networking
- Size: 3 to 8,955 papers (Cluster(CL) 1 to 10 cover more than 85%)
- Average published year: 2001.7

Cluster	Numbers of papers (Node)	Edge	Density	Ave. year
All	35399	167896	4.74	2001.7
1	8955	34131	3.81	2001.3
2	7163	34684	4.84	2002.0
3	5766	52261	9.06	2004.0
4	4896	21616	4.42	2000.8
5	953	2931	3.08	2005.0
6	593	1414	2.38	2000.7
7	582	1169	2.01	2003.8
8	443	1151	2.60	2002.5
9	389	1910	4.91	2003.8

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5. Search for useful knowledge

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	Key concept	Detail description
SubCL 2-4	(i) Foot hairs of gecko (Setae)	<p>Mechanism Van der Waals force</p> <p>Adhesion force 0.1 N/mm² of pad area with 5×10³ setae</p> <p>Advantage Rapid detachment and reattachment Used many times with almost the same adhesion force</p> <p>Challenge To fabricate artificial surface which has the same property because of the large number of parameters</p>
	<p>Reference Autumn, K et al, <i>NATURE</i>, V405, P681 (2000) Boesel, LF et al, <i>ADV MATER</i>, V22, P2125 (2010)</p>	

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5. Search for useful knowledge

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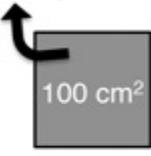


	Key concept	Detail description
SubCL 4-3	(ii) Mussel adhesive protein	<p>Mechanism -Mussels have five protein families known as Mytilus edulis foot proteins (Mefp). Mefp 3 and 5 are highly hydroxylated and form numerous hydrogen bonds and metal complexes.</p> <p>Adhesion force 1N/(3mm diameter circle = 10⁻⁵ m²)</p> <p>Advantage Strong adhesion under water (wet) environment</p>
	<p>Reference Lee, H et al, <i>P NATL ACAD SCI USA</i>, V103, P12999 (2006) Wiegemann, M, <i>AQUAT SCI</i>, V67, P166 (2005) Lin, Q et al, <i>P NATL ACAD SCI USA</i>, V104, P3782 (2007)</p>	

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5. Search for useful knowledge



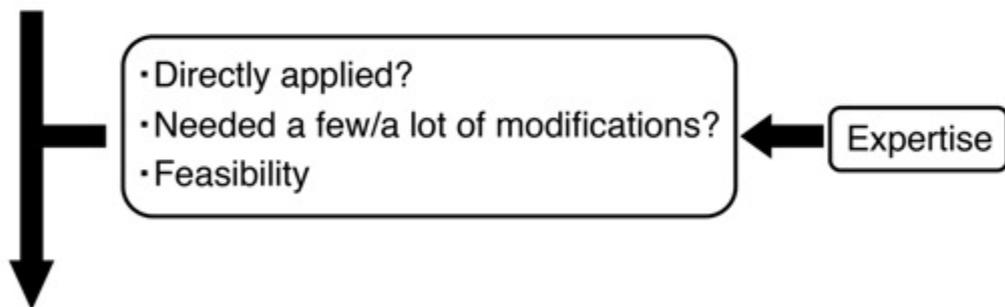
	Key concept	Detail description
SubCL 4-3	(iii) A reversible wet/dry adhesive inspired by mussels and geckos	<p>Mechanism</p> <ul style="list-style-type: none"> • Mentioned in the previous slides <p>Adhesion force 1.2 kN to separate</p> <ul style="list-style-type: none"> • 120 nN/pillar (in air) • 80 nN/pillar (in water)  <p>Advantage</p> <ul style="list-style-type: none"> • Rapid detachment and reattachment • Water resistance • Keep the performance for over 1000 cycles in both dry and wet environments
	Reference	Lee, H et al, <i>NATURE</i> , V448, P338 (2007)

6. Apply to CFRP



I acquired useful knowledge from the other fields.

- (i) Foot hairs of gecko
- (ii) Mussel adhesive protein
- (iii) A reversible wet/dry adhesive inspired by mussels and geckos



A New solution from (iii) !!

6. Apply to CFRP



Concept	Detail description
<p>(iii) A reversible wet/dry adhesive inspired by mussels and geckos</p> <p>CL 4-3</p>	<p>Directly applied to secondary structure of airplanes</p> <ul style="list-style-type: none"> • Enough adhesion force • Good performance in rain • No fasteners for joint → Weight reduction and fuel saving • Easy replacement → Short time & low cost maintenance

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	Key concept	Detail description	Application
CL#3	<p><u>Dentin bonding</u></p> <p>Phosphoric acid (PH1.5-2.0)</p> <p>樹脂含浸層(表面数μmが脱灰しレジンモノマーが進入)</p>	<p>All-in-one adhesive (acid treatment, washing, priming, bonding)</p> <p>→ reduce handling time / uniformity / water resistance</p>	<p>表面処理で強度を上げる論文は多いので、これと接着を一気にやってしまう(現状のadhesiveの材料について知る必要がある)</p>
CL#8	<p><u>Joint type & adhesive</u></p>	<p>Japanese traditional joint methods for wood beams</p> <p>→ easy replacement / no nail</p>	<p>*reduce fastener (not "no" fastener)</p> <p>*apply to second structure like floor beam, winglet and 尾翼のさらに後方</p>

Apply to CFRP

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Results of hearing survey

“This methodology is very effective when researchers try to find interesting ideas about problems. It may be useful when researchers make proposals to a person or an institution that offers financial assistance. I want to use it. (A researcher of CFRP in JAXA (Japan Aerospace Exploration Agency))”

“The application sounds interesting. Short time and low cost maintenance are very beneficial for airlines. I want to know whether the adhesive is commercially available or not. (A professor at the University of Tokyo)”

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システム改善

- 可視化、様々な分析が可能に
(デモンストレーション)



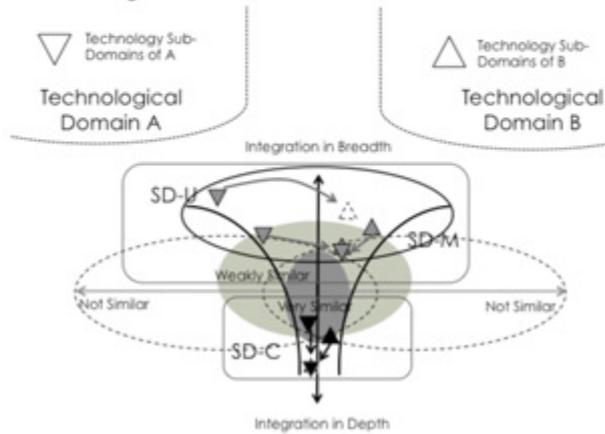
- 公開にはISI Web of Science
の登録が必要？

特許分析

自動車と航空の特許比較



Similarity分析手法の検討

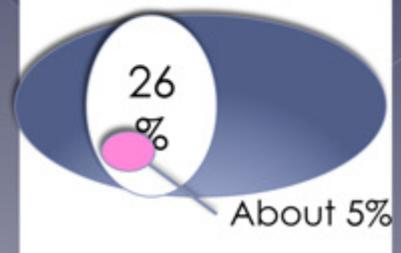


航空／自動車の知統合予測研究

Automobile Patents
 (Tyt, Hnd, Nssn, Mzd, Mtsbst)
 242305 patents
 2001.8 average yr
 (MC: 60458, 1.4 edge a)

Aviation Patents
 (Boeing, Airbus, RR, PW, Tier1)
 27989 patents
 2002.0 average yr
 (MC: 8281, 2.2 edge ave.)

3
 -Use Citation Analysis Method
 -Focus pairs of clusters measured as high similarity



今後

- 学際的研究支援／発見支援の手法の検討を行っていききたい。

