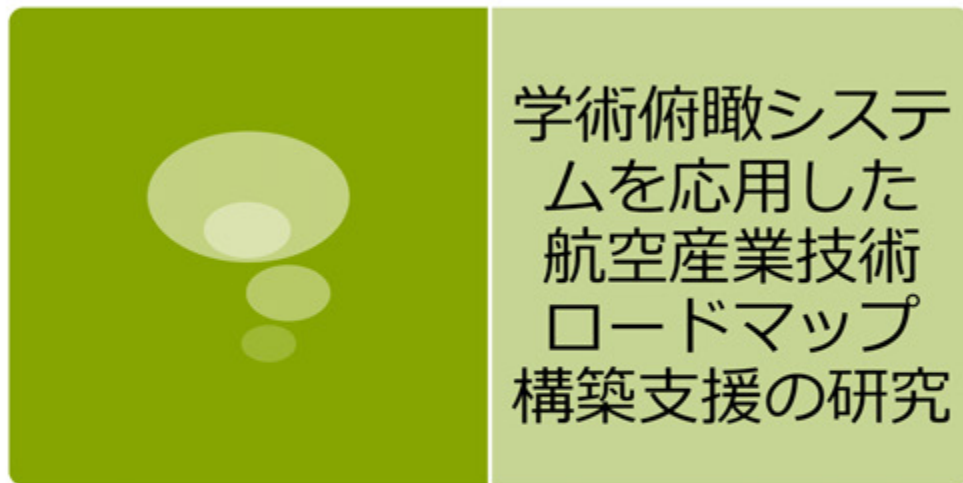


平成 24 年度 航空プログラムグループ公募型研究
（国産旅客機高性能化技術研究開発）

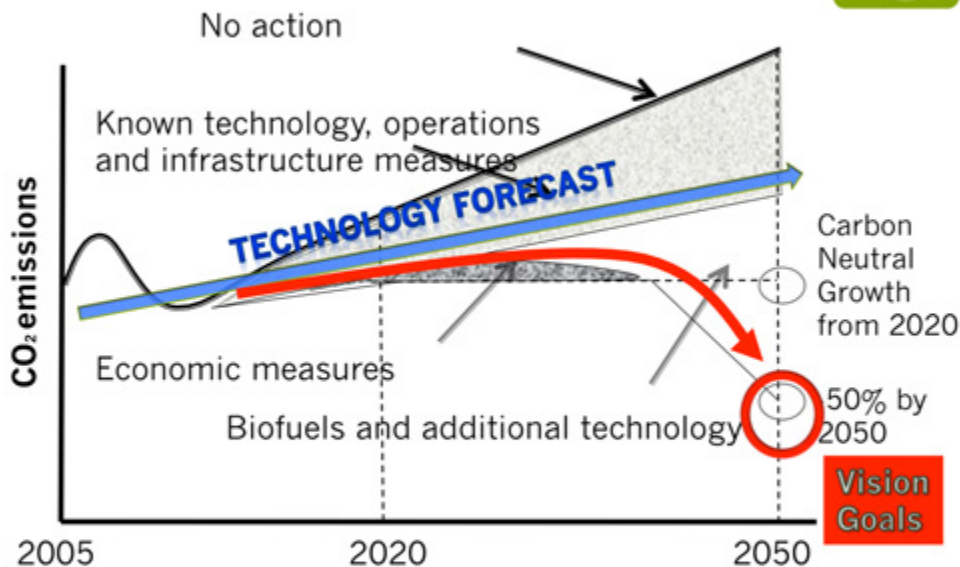


東京大学 総括プロジェクト機構 航空イノベーション総括寄付講座
特任研究員 中村裕子

Contents

- 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

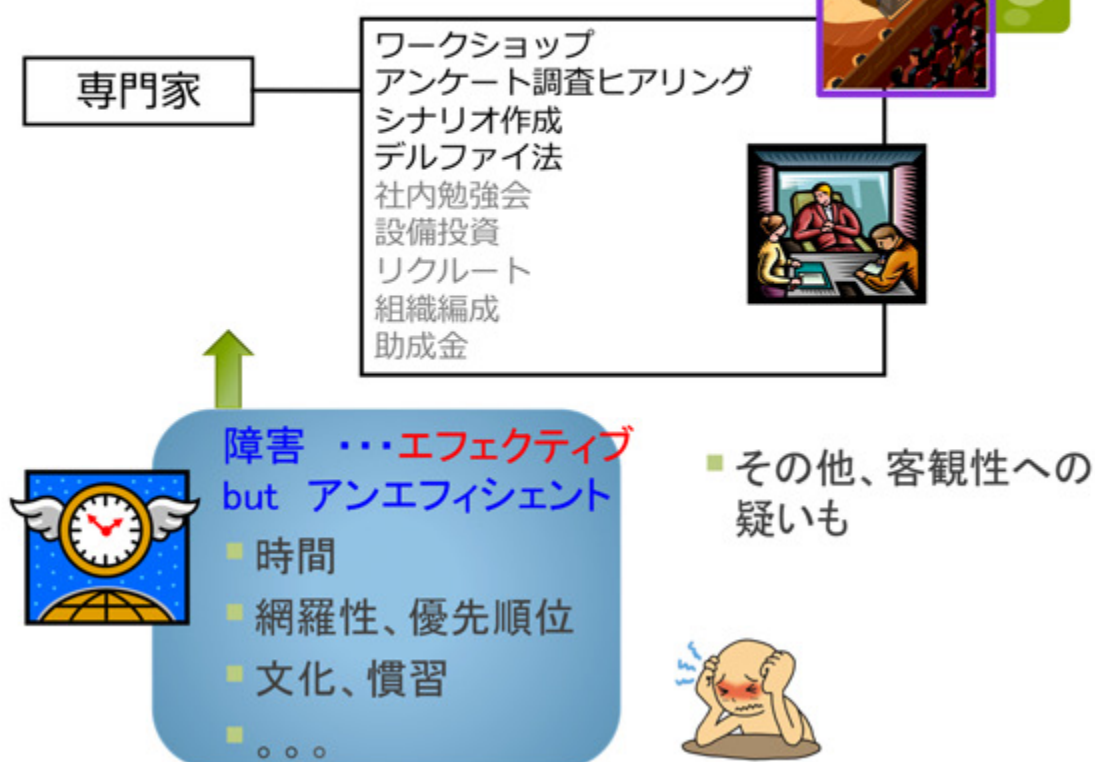
背景：技術ロードマップ



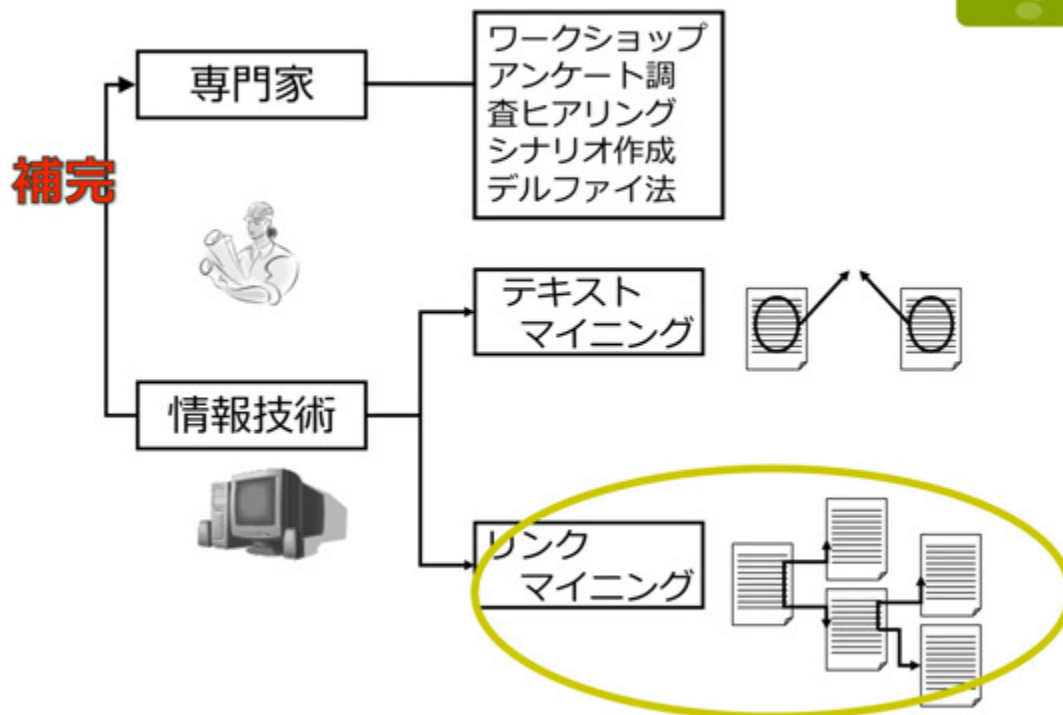
道筋を示し、リソースを集め、ゴールに導くのがロードマップの本質

しかし、ロードマップは生ものである。

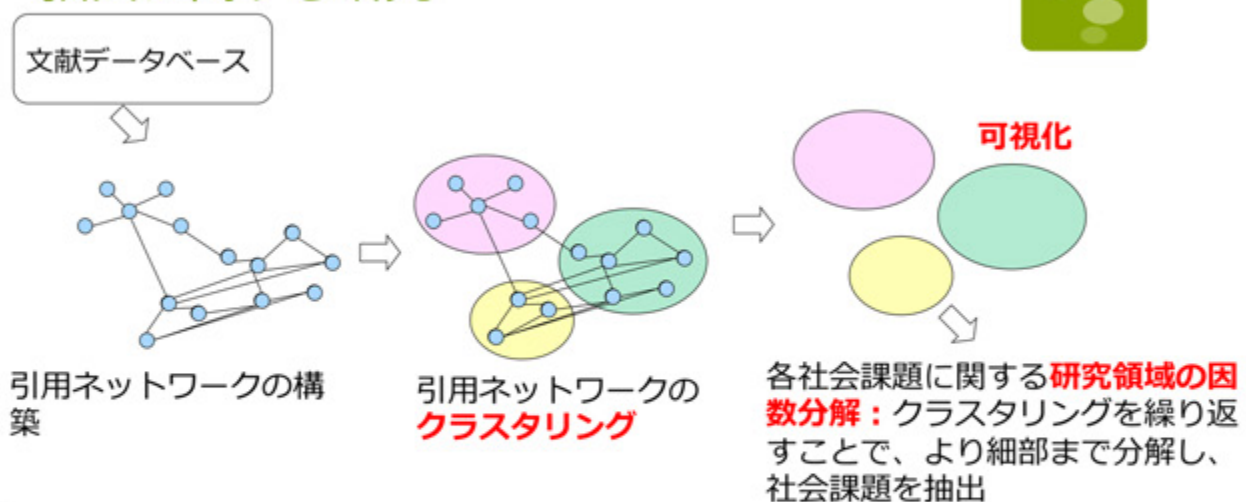
日々変化する環境に対応するため
必要な技術トレンド等の更新



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

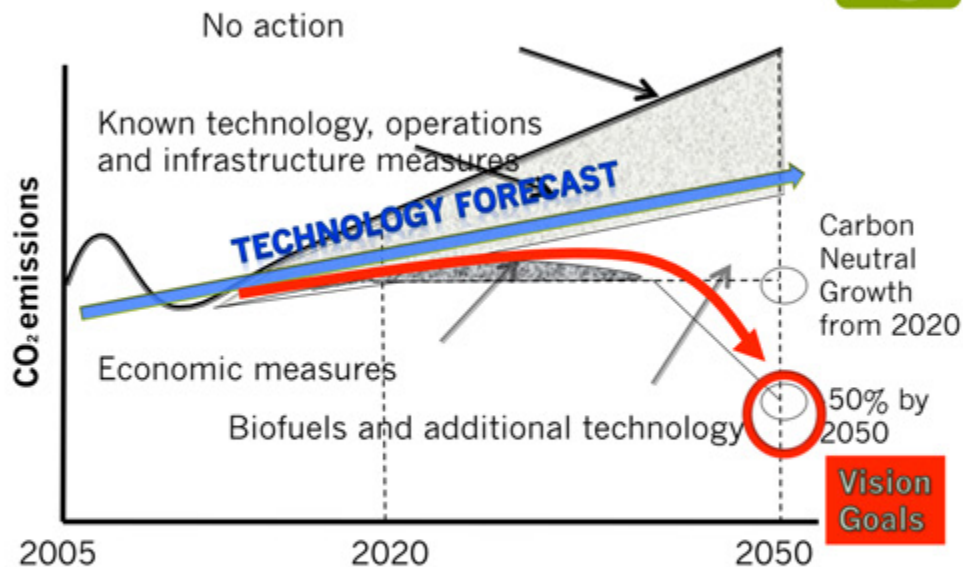
- Corpus cleansing : Shibata et al. *JASIST*, in press.
- Link definition : Shibata et al. *JASIST* (2009)
- Clustering : Newman & Girvan, *Phys. Rev. E* (2004)
- Clustering quality : Takeda & Kajikawa, *Scientometrics* (2010)
- Topological measure : Guimera & Amaral, *Nature* (2005)
- Visualization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

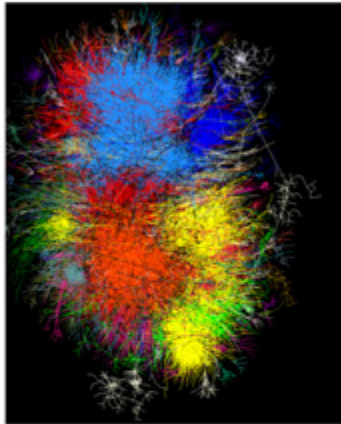


Trend把握、方策検討に貢献したい。

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ぼった具体的な分析 → 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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The University of Tokyo



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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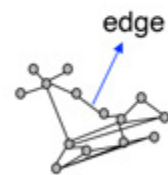
1. Collect the data of papers

- 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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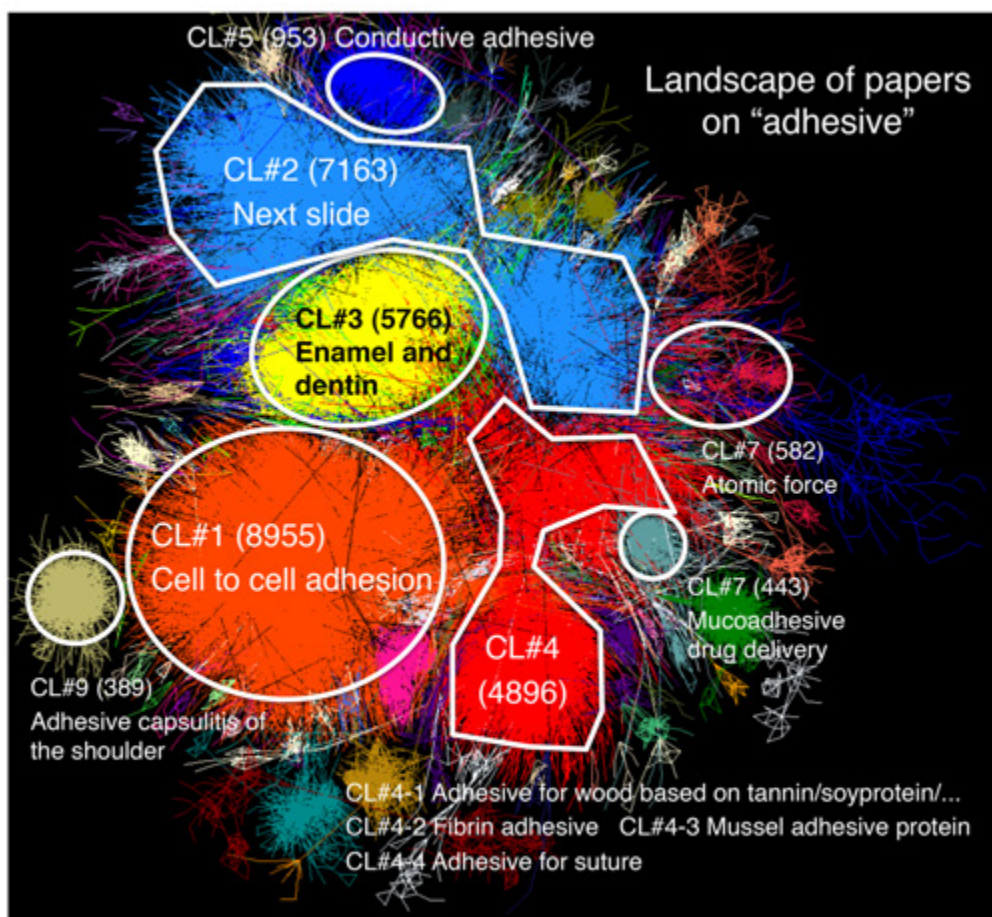


4. Divide the component into clusters

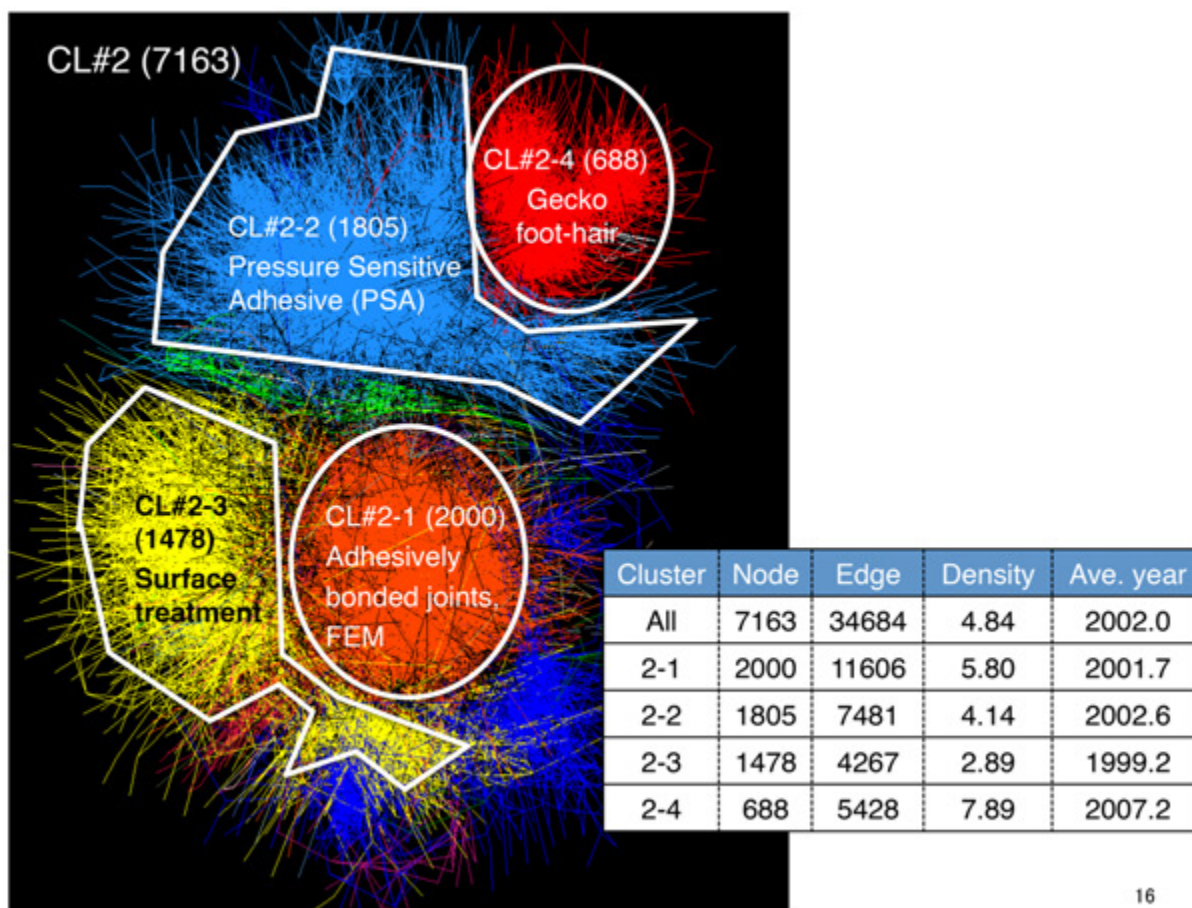
- 239 clusters were created by Newman's networking
- Size: 3 to 8,955 papers (Cluster(CL) 1 to 10 cover more than 85%)
- Average published year: 2001.7

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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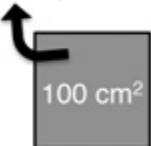
	Key concept	Detail description
SubCL 4-3	(ii) Mussel adhesive protein	<p>Mechanism -Mussels have five protein families known as Mytilus edulis foot proteins (Mefp). Mefp 3 and 5 are highly hydroxylated and form numerous hydrogen bonds and metal complexes.</p> <p>Adhesion force 1N/(3mm diameter circle = 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

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	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
	<p>Reference Lee, H et al, <i>NATURE</i>, V448, P338 (2007)</p>	

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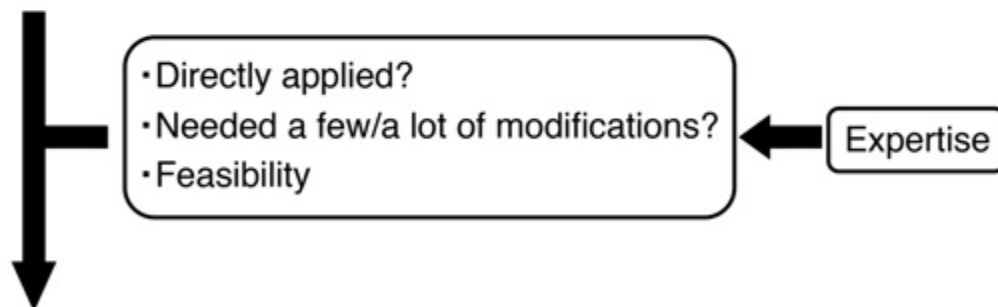
6. Apply to CFRP

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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



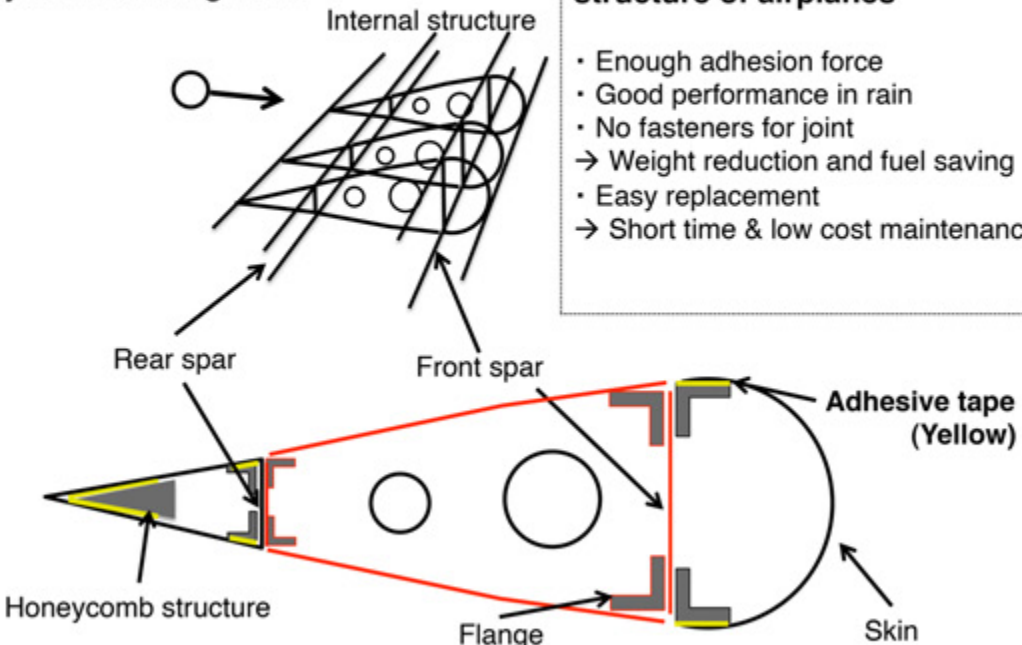
A New solution from (iii) !!

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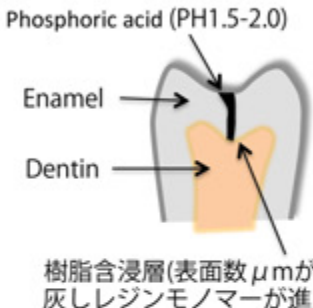

6. Apply to CFRP

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	Concept	Detail description
CL 4-3	<p>(iii) A reversible wet/dry adhesive inspired by mussels and geckos</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 <p>→ Weight reduction and fuel saving</p> <ul style="list-style-type: none"> • Easy replacement <p>→ Short time & low cost maintenance</p>

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	Key concept	Detail description	Application
CL#3	<p><u>Dentin bonding</u></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)



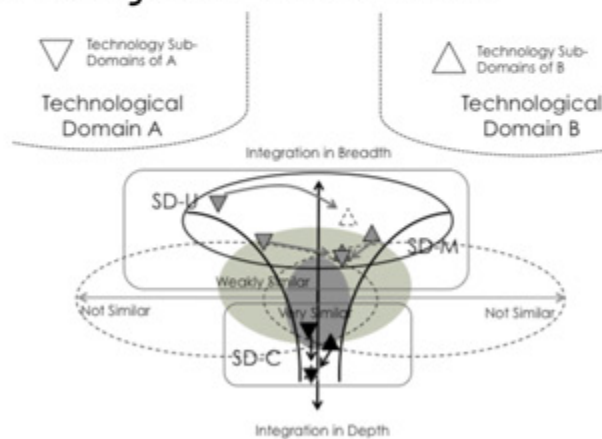
- 公開にはISI Web of Science
の登録が必要？

特許分析

自動車と航空の特許比較



Similarity分析手法の検討

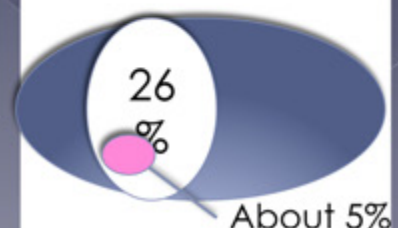


航空／自動車の知統合予測研究

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たい。

