PATENT SIMILARITY

AN ANALYSIS TOOL AND APPLICATIONS

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Based on joint work with Michael Natterer, Matthias Pötzl, Georg von Graevenitz, Stefan Wagner

IP Statistics for Decision Makers Conference

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MAX-PLANCK-GESELLSCHAFT

Agenda

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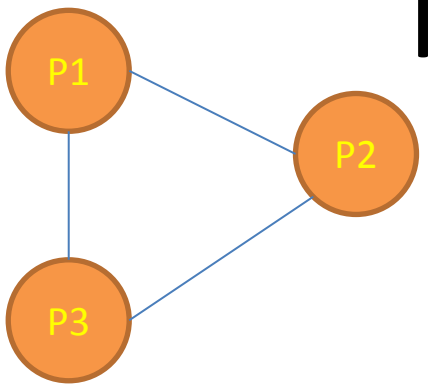
The Basic Idea



Questions

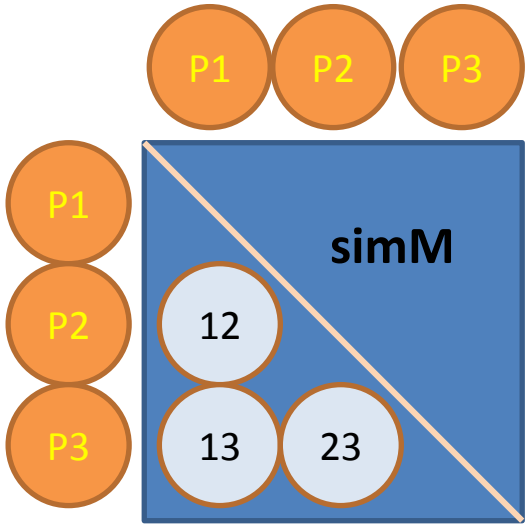
- How do patents relate to each other?
- Are they „close“ or „distant“ to each other in technology/content space?
- … more close/distant to a focal point than other patents?

Some answers

- references/citations
- common bibliographic elements (inventor, applicant, technology class, …)
- density/concentration measures
- …

Our Approach

A Similarity Matrix



… of considerable size

The Basic Idea

- Similarity matrices may be (and are being) used for
  - clustering exercises (e.g. within applicant or national portfolios) and analysis of such clusters
  - search for similar technical art
  - detection of areas within the patent system with high average similarity among patents (possibly: thickets?)
  - modeling of impact of competition on patent value, litigation, etc.
  - analyzing „patent quality“
  - analyzing relatedness of R&D activities and of technological rivalry

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Methods and First Checks

- computation of similarity measures using a multi-step approach (based on title, abstract, claims *and description*)
- obtain text information from bulk delivery services such as OPS, other public databases or via the EPO‘s data products
- process text elements (cleaning and standardization, stemming, …) to generate keyword vector
- apply similarity calculations (cosine, Jacard, …)

Methods and First Checks

- large number of technical issues (storage, speed, matrix representation)
- careful optimization of process parameters needed
- recall and computation times strongly dependent on text types used
- first robustness and plausibility checks – similarity increases with …
  - #same inventor(s)
  - #same applicant(s)
  - #same IPC(s)
  - distance in time (application lag)

Methods and First Checks

Simple OLS – similarity as a function of patent (pair) characteristics

$$\mathbf{simM}_{ij} = \beta_0 + \beta_1 * \#\mathbf{same}\ IPC4_{ij} + \beta_2 * \#\ \mathbf{same}\ \ IPC_{ij} +$$
$$+ \beta_3 * \#\mathbf{same\ inventors}_{ij} + \beta_4 * \mathbf{same\ applicants}_{ij} +$$
$$+ \beta_5 * \mathbf{same\ application\ authority}_{ij} + \beta_6 * \mathbf{filing\ lag}_{ij} + \ e_{ij}\ .$$

Source: Natterer (2014, ch. 7)

Methods and First Checks

Dependent Variable: Similarity (0…100)						
Independent variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
# same IPC4 codes	0,233***		0,140***	0,141***	0,140***	0,127***
	[0,032]		[0,025]	[0,025]	[0,025]	[0,024]
# same IPC codes		10,286***	8,631***	8,279***	8,261***	8,162***
		[0,211]	[0,221]	[0,219]	[0,218]	[0,214]
# same inventors				13,222***	13,189***	13,156***
				[0,827]	[0,825]	[0,828]
# same applicants				4,440***	4,353***	4,441***
				[0,153]	[0,152]	[0,147]
same appl. authority					0,195***	0,284***
					[0,020]	[0,019]
Δ filing date(100 days)					-0,005***	-0,003***
					[<0,001]	[<0,001]
# observations	17.997.000	17.997.000	17.997.000	17.997.000	17.997.000	17.997.000
F values	1.414***	14.709***	5.374***	4.677***	17.792***	60.168***
Adjusted R^2	0,025	0,044	0,051	0,056	0,060	0,084
adjusted standard errors in brackets						

Source: Natterer (2014, Table 7-1)

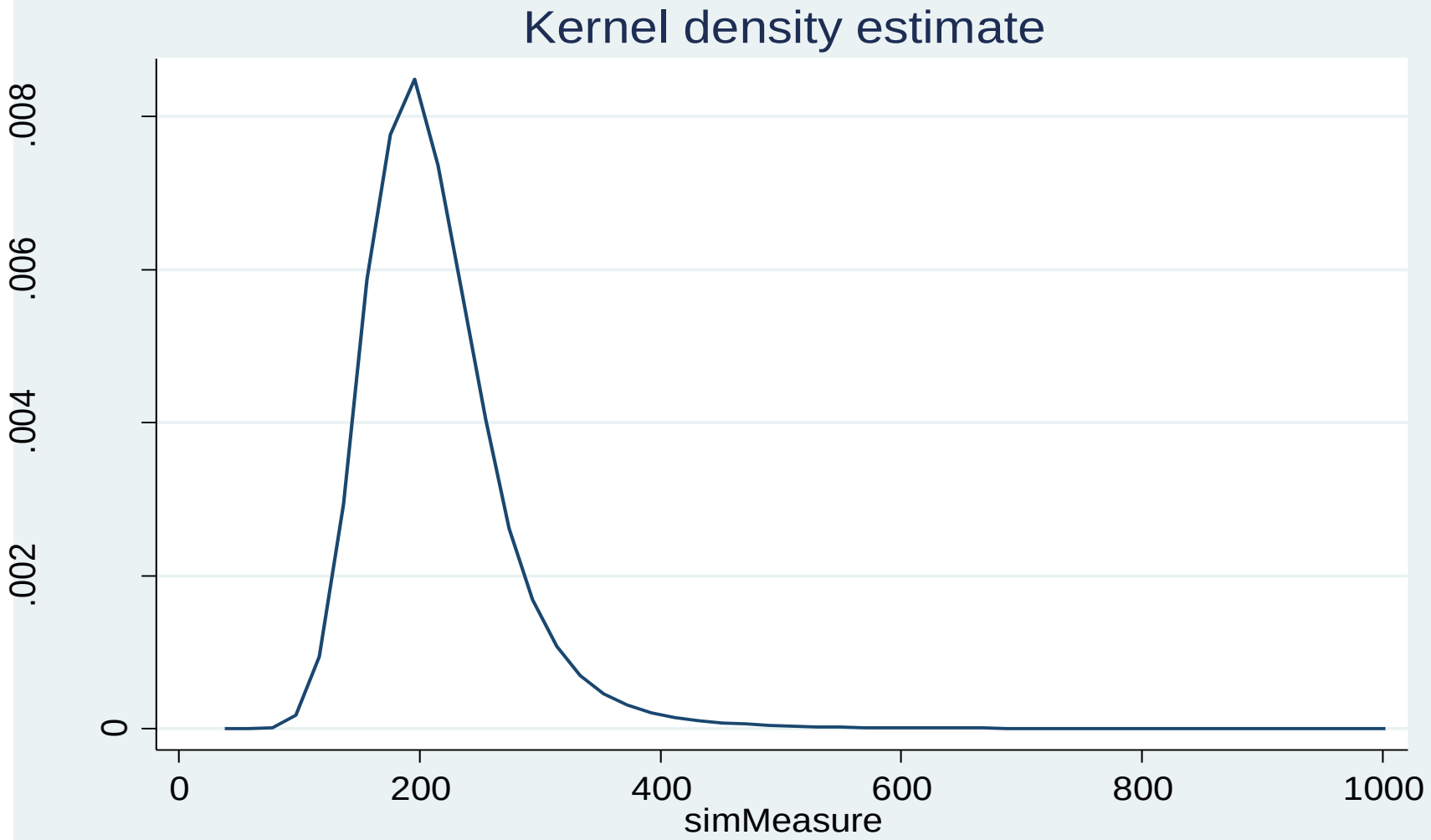
Methods and First Checks

Results for Electrical Engineering

- main area (MA) 1 (Schmoch et al.)
- transition from patent to patent family
- in Patstat 2013/10: 773,914 DOCDB families with at least one IPC code in MA1
- size of dataset: 773 million DOCDB pairs (for each pair of patents only the *1000 most similar* ones are recorded)
- restriction to families with first publication date(s) between 1.1.2000 and 31.12.2010: 368 million observations (pairs) on patent similarity
- note: similarity values scaled between 0 and 1000

Methods and First Checks

Results for Electrical Engineering



Methods and First Checks

Results for Electrical Engineering

- DOCDB families „under-aggregate“ – several thousand cases with (almost) identical documents and same applicant
- (early) measures of „performance“ (*without* use of descriptions)
  - about 50 percent of EPO references (mostly provided by examiner) found among most similar patents
  - half of these among the 50 most similar patents
- analysis and application to USPTO references (mostly applicant provided) still going on

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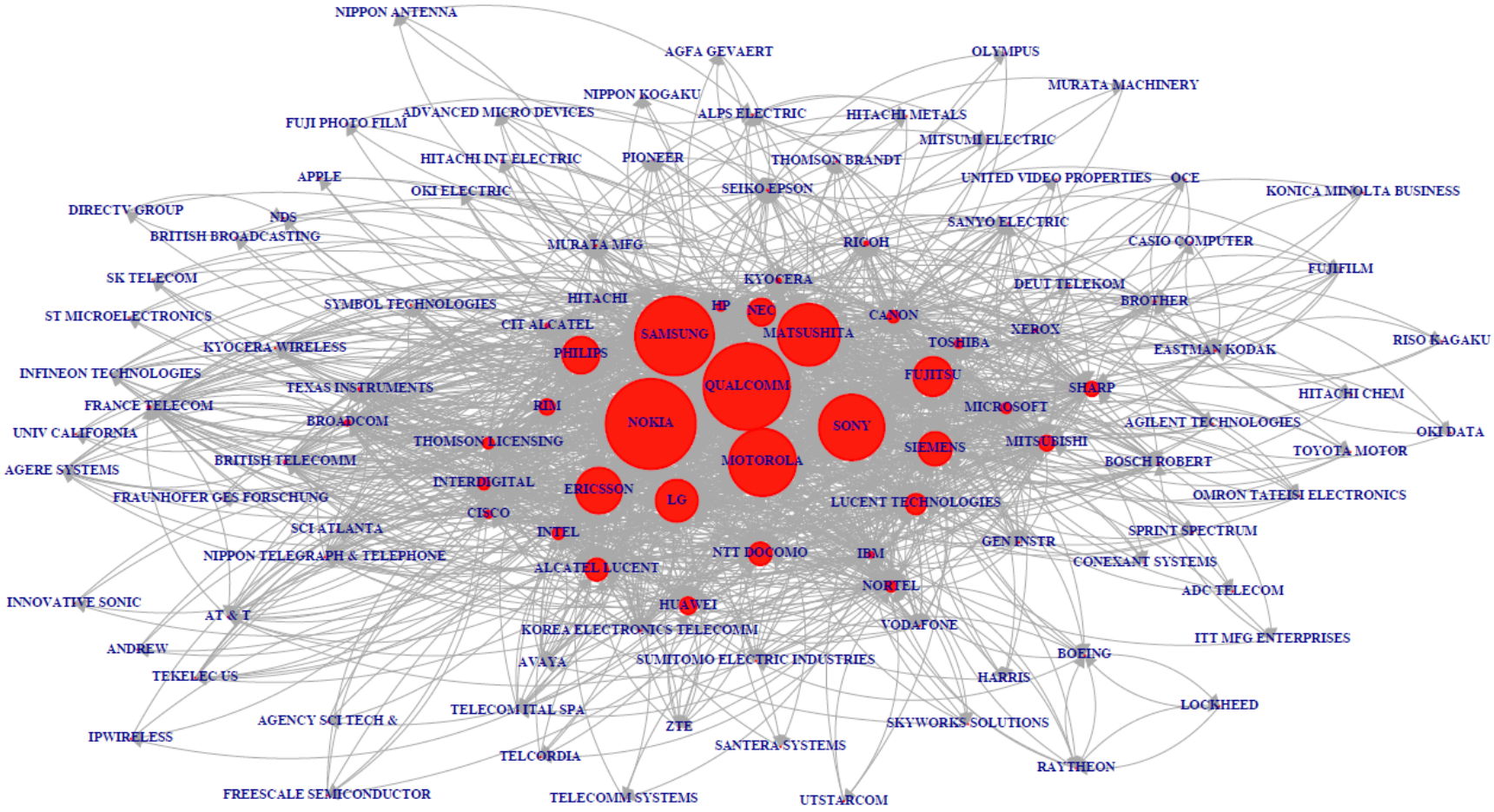
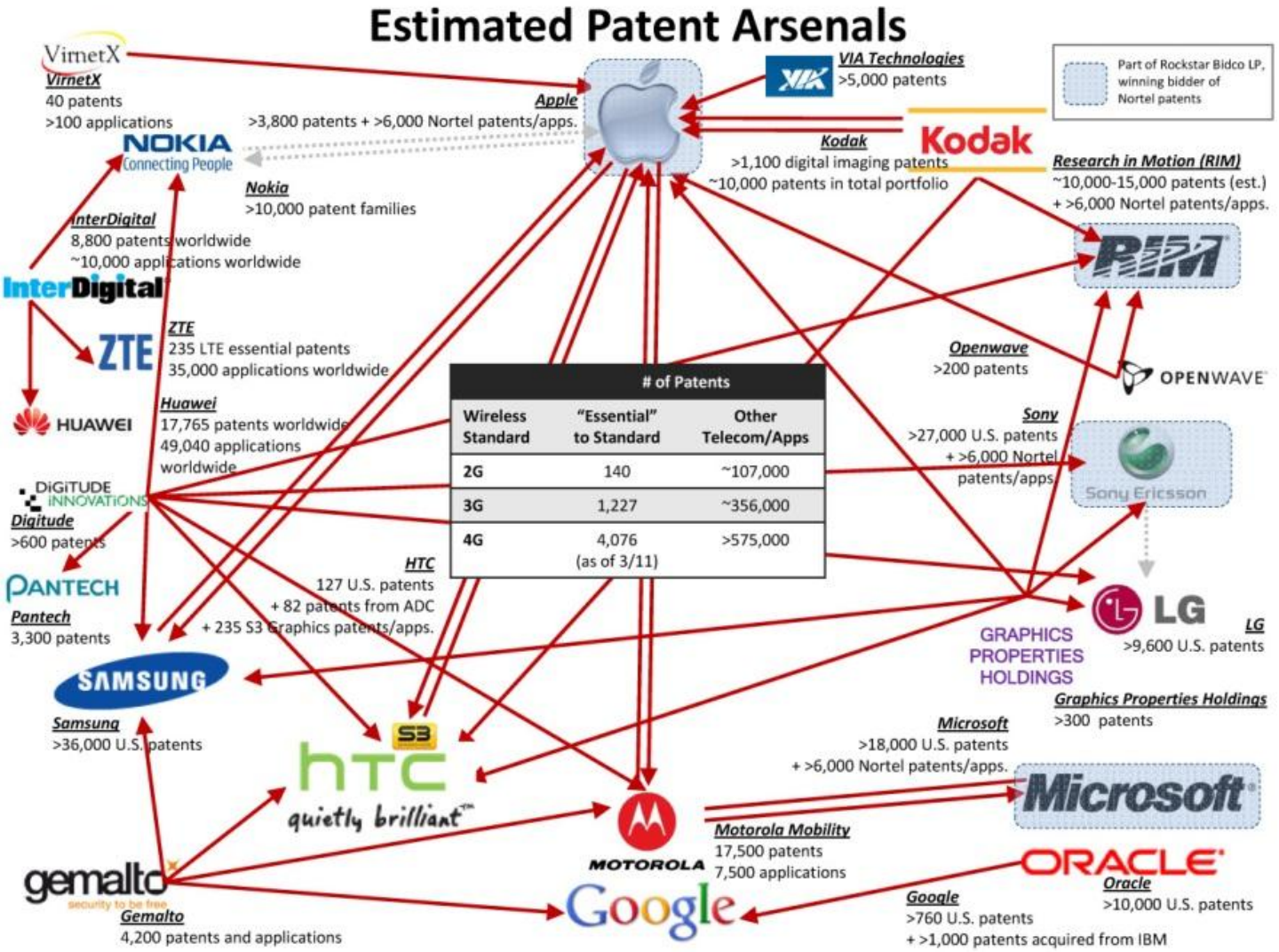
Application 1: Patent Thickets



Source: Own graph, based on EP/WO citation data.

Application 1: Patent Thickets



Quelle: http://www.pcmag.com/article2/0,2817,2399098,00.asp

Application 1: Patent Thickets

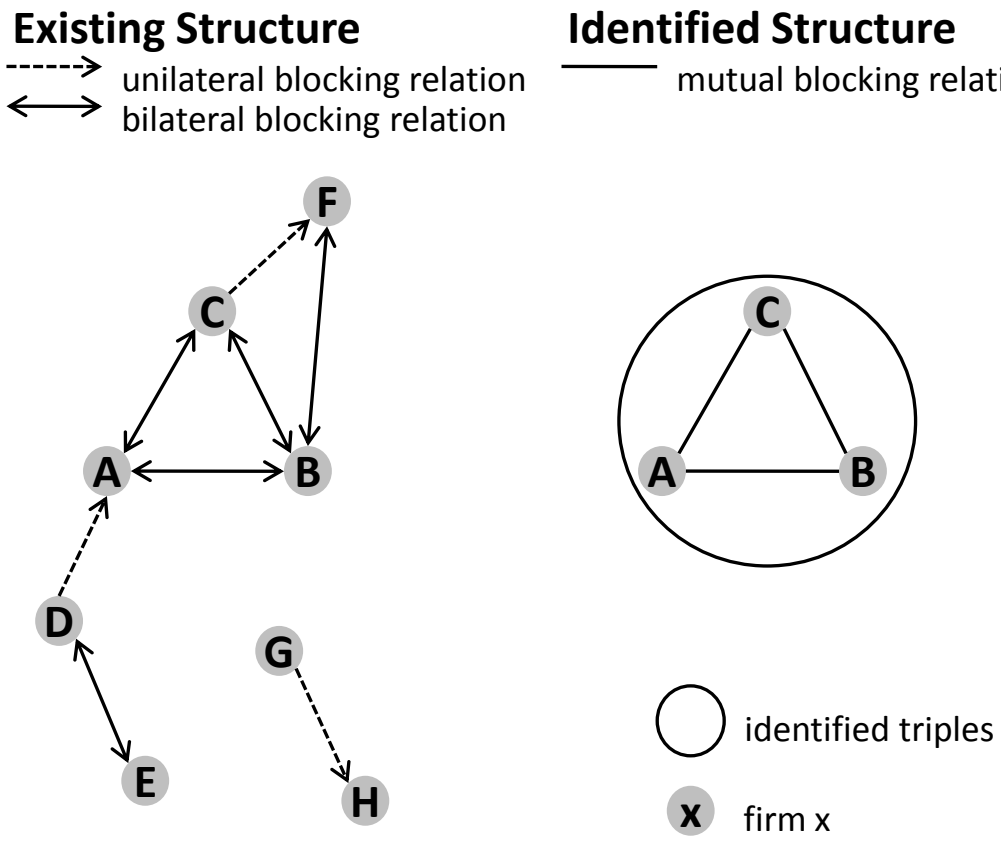
- Demand for patent rights has been growing steadily
- Large portion is argued to be "weak" or marginal in terms of their contribution to the state of the art (Jaffe and Lerner 2004, Bessen and Meurer 2008, Lei and Wright 2009)
- Patent thickets are characterized in the literature by overlapping claims and/or dispersed ownership. The exact definition is controversial (Cockburn and MacGarvie 2009, Noel and Schankermann 2006, Hall and Ziedonis 2001)
- in extant literature two „measures" of thickets
  - fragmentation of ownership (Ziedonis 2004)
  - „triples" (Graevenitz et al 2011)

Application 1: Patent Thickets

- *Fragmentation (Ziedonis 2004)*
  - focus on who owns relevant prior art to which the owner of the focal patent may have to gain access
  - extreme concentration: simple one-to-one negotiations
  - extreme fragmentation: complex negotiation with high transactions costs
  - usually computed as a Herfindahl measure (more reliable for cases with many prior art references)

Application 1: Patent Thickets

- *Triples (Graevenitz et al 2009)*



Application 1: Patent Thickets

- Both measures based on references (citations)
  - concentration of ownership
  - incidence of interrelated and complex patenting positions
  - apparently independent, but related effects (no substitutes)
- Both measures may have *disadvantages* when the number of references is small.
- Similarity measures may help to detect additional effects of patent density, i.e. of encountering a large number of similar patents in one‘s environment.
- They do not suffer from detrimental effects of low numbers of references.
- Measure used here: *p95* of simM

Application 1: Patent Thickets

Dependent Variable: Opposition (0/1)		(1)	(2)
VARIABLES (sel.)		Coeff.	Coeff.
number of area triples	YA	-0.0096*** [0.001]	-0.0062*** [0.001]
p95 of simM/100	P		-0.017*** [0.002]
concentration of rivals' patents	FYA	4.7258*** [0.589]	3.9713*** [0.488]
Fragmentation	FYA	0.1368*** [0.007]	0.0973*** [0.009]

Note: F- firm, Y - year, A - area, P – patent.
Control variables include: technical area dummies, type of applicant, number of claims, size of patent family, number of citations, share of X and Y citations, et al. See Harhoff et al. (2013) for a complete list of covariates.

N=966,974 - Log Likelihood: (1) -196047, (2) -196039

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Application 2: International Search Reports

- In the PCT application process, ISAs (International Search Authorities) generate search reports (ISRs) …
- … according to the same rules, ideally using the same decision-making criteria.
- In fact: many differences in organization and procedures.
- Excellent study: Tesuo Wada and Setsuko Asami, „Quality comparisons of International Search Reports“ – presented at the Hitotsubashi Workshop on Knowledge, IP and Innovation
- Result: EPO generates more complete ISRs than JPO and USPTO, measured in terms of ISR coverage ratio.
- Do ISRs generated by different ISAs differ in terms of similarity of detected prior art?

Application 2: International Search Reports

ISA	MA1	MA2	MA3	MA4	MA5
EPO	265	256	275	290	267
JPO	311	280	306	317	283
USPTO	255	249	262	277	259

Note: Own computations of mean similarity values for pairs of focal patents and references given in ISRs. PCT filings with priority dates 2000-2008. Similarity values are scaled between 0 and 1000. Not shown in table: results for ISAs AT, AU, BR, CA, CN, ES, FI, IL, KR, RU, SE.

Application 2: International Search Reports

- Hence, ISR coverage points to quality advantages for EPO, similarity values are not fully congruent with that result.

Further results (preliminary – to be explored)

- Low similarity values in non-EPO ISRs trigger A4 publications (supplementary search).

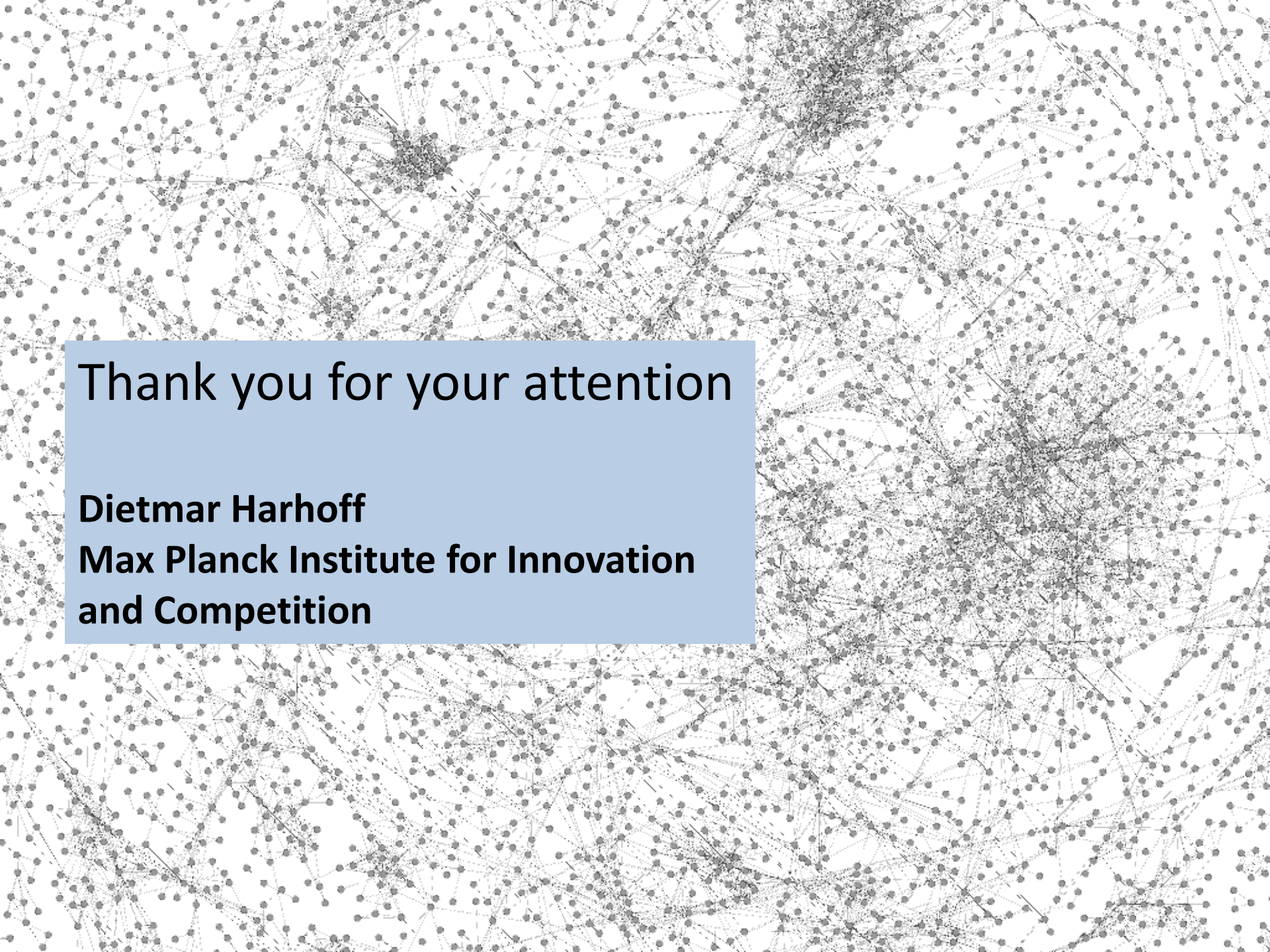
- Ranking of similarity values by source of references in EPO search reports: applicant > examiner > opposition > Rule 115.

Agenda

Concluding Comments

- Review
  - promising „new“ approach for resesarch and practice
  - IT-intensive exercise with numerous big data issues
  - detection of highly similar patents feasible even without description texts (but inclusion of the latter recommended)
  - high recall rates of examiner references

- Outlook
  - more work on calibration of similarity models/optimization
  - inclusion of descriptions (across all main areas)
  - computation of measures analogous to „triples“
  - extension to NPL references and publications


Thank you for your attention
Dietmar Harhoff
Max Planck Institute for Innovation and Competition