On Term Selection Techniques for Patent Prior Art Search

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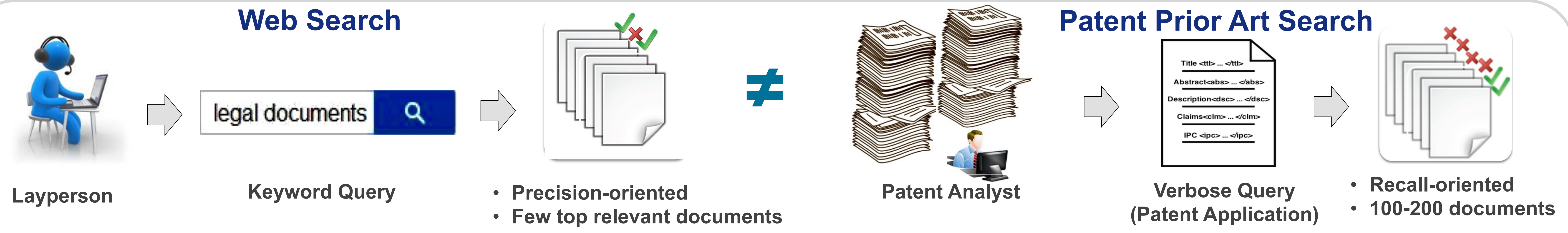
Introduction



- Precision-oriented
- Few top relevant documents

- Recall-oriented
- 100-200 documents

Patent Prior Art Search: Finding previously granted patents or any published work relevant to new patent application.

Data Collection: English subset of CLEF-IP 2010 [1].

PATATRAS: Highly engineered system and top CLEF-IP 2010 competitor [2].

Previous Work: Mainly focused on different query expansion techniques to cope with significant term mismatch [3].

Problem Definition: Generic IR techniques (e.g., different query reformulation) are ineffective for patent prior art search!

Oracular Term Selection

1. Relevance Feedback Score

Relevance feedback (RF) score for each term ($\mathbf{t} \in \{\text{top-100}\}$):

$$\mathbf{RF}(\mathbf{t},\mathbf{Q}) = \mathbf{Rel}(\mathbf{t},\mathbf{Q}) - \mathbf{Irr}(\mathbf{t},\mathbf{Q}) \quad (\mathbf{1})$$

where

$$\mathbf{Rel}(\mathbf{t}) \rightarrow \mathbf{Avg.\ Term\ Frequency\ in\ Rel.\ Docs.}$$
$$\mathbf{Irr}(\mathbf{t}) \rightarrow \mathbf{Avg.\ Term\ Frequency\ in\ Irr.\ Docs.}$$

2. Oracular Query Formulation

Formulate two oracular queries:

① Oracular Query = $\{\mathbf{t} \in \mathbf{top-100} | \mathbf{RF}(\mathbf{t},\mathbf{Q}) > \tau\}$

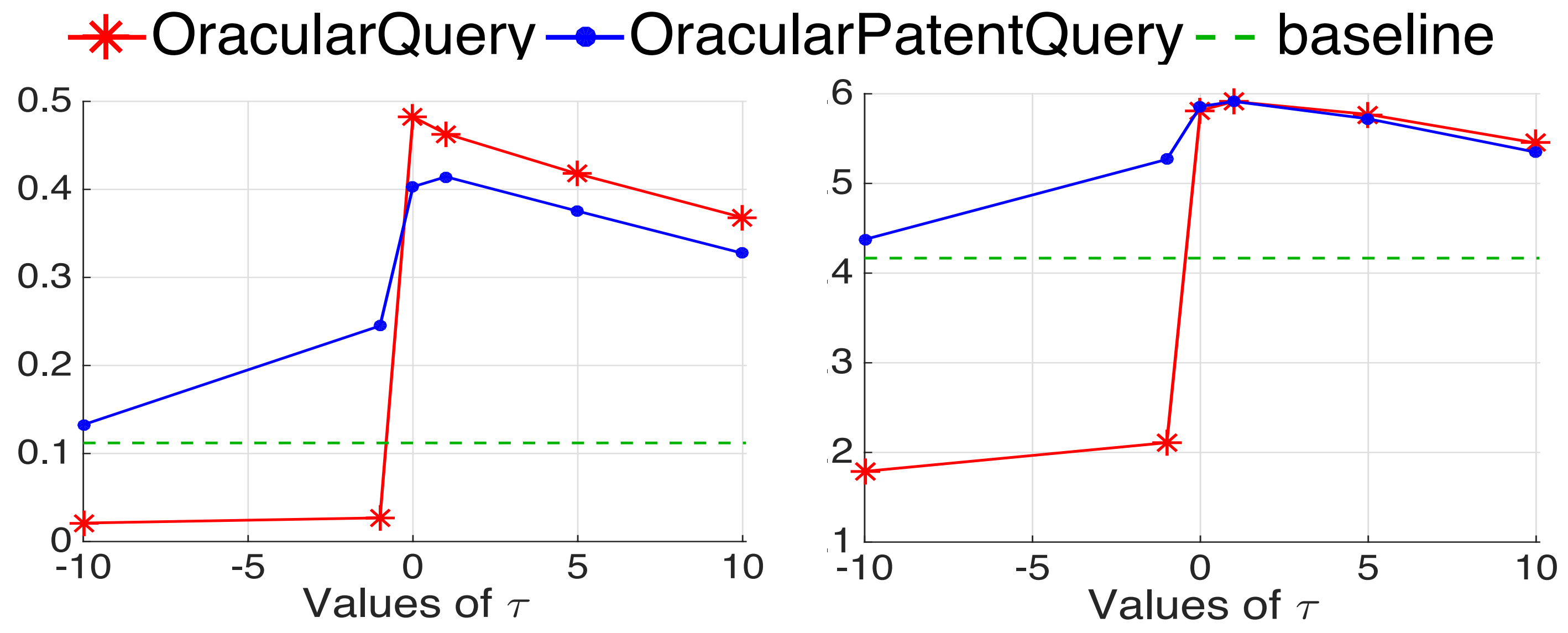
② Oracular Patent Query = $\{\mathbf{t} \in \mathbf{Q} | \mathbf{RF}(\mathbf{t},\mathbf{Q}) > \tau\}$

Take Home Message
- Sufficiency of terms in baseline query
- Precise methods to eliminate poor query terms (query reduction)

3. Baseline vs. Oracular Query

Table.1: Performance for the Baseline Query, two variants of the Oracular Query, and PATATRAS.

		Baseline	PATATRAS	Oracular Query	Oracular Patent Query
LM	MAP	0.112	0.226	**0.482**	**0.414**
	Recall	0.416	0.467	0.582	0.591
BM25	MAP	0.123	0.226	**0.492**	**0.424**
	Recall	0.431	0.467	0.584	0.598

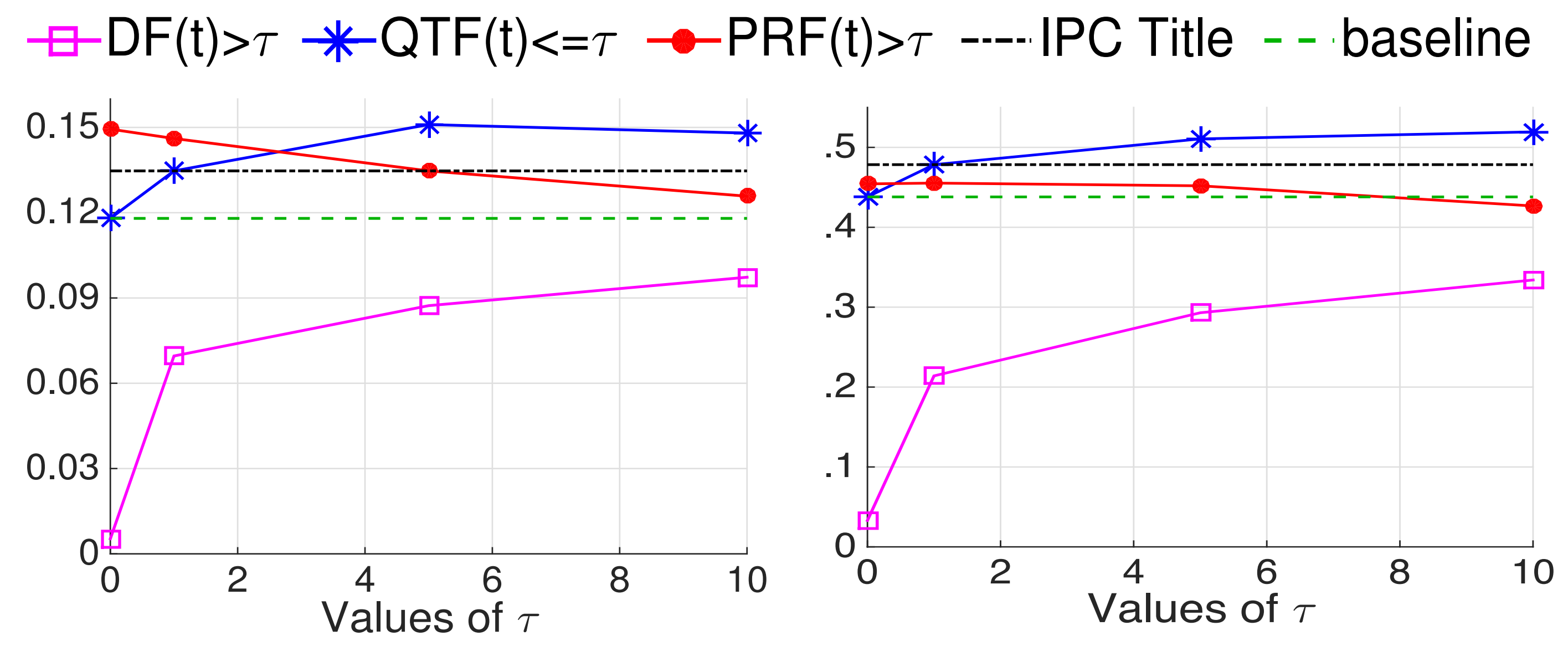


(a) MAP (b) Recall

Fig.1: Comparing the performance of two different oracular queries.

Query Reduction (QR): Approximating Oracular Query

1. Automated Reduction



(a) MAP (b) Recall

Fig.2: System performance vs. the threshold τ for four QR approaches.

QR Approaches:
1. Pruning document frequent (DF) terms ($DF(t) > \tau$).
2. Pruning query infrequent terms ($QTF(t) <= \tau$).
3. Pseudo relevance feedback term selection ($PRF(t) > \tau$).
4. Pruning IPC title general terms.

Take Home Message
- Proposed QR methods **fail** to approximate oracular query.
- They cannot **discriminate** between useful and noisy terms.

2. Semi-automated Interactive Reduction

Table.2: Performance of an Oracular Patent Query derived from only the top-k ranked relevant documents identified in the search results. We assume that the remaining documents in the top-100 are irrelevant.

	Baseline	PATATRAS	Oracular Patent Query (k=1)	Oracular Patent Query (k=3)
MAP	0.112	0.226	**0.289**	**0.369**
Avg. Recall	0.416	0.467	0.484	0.547

- MAP **Doubles** over the baseline (0.112 → 0.289)
- **Outperforms** PATATRAS (0.226 → 0.289)

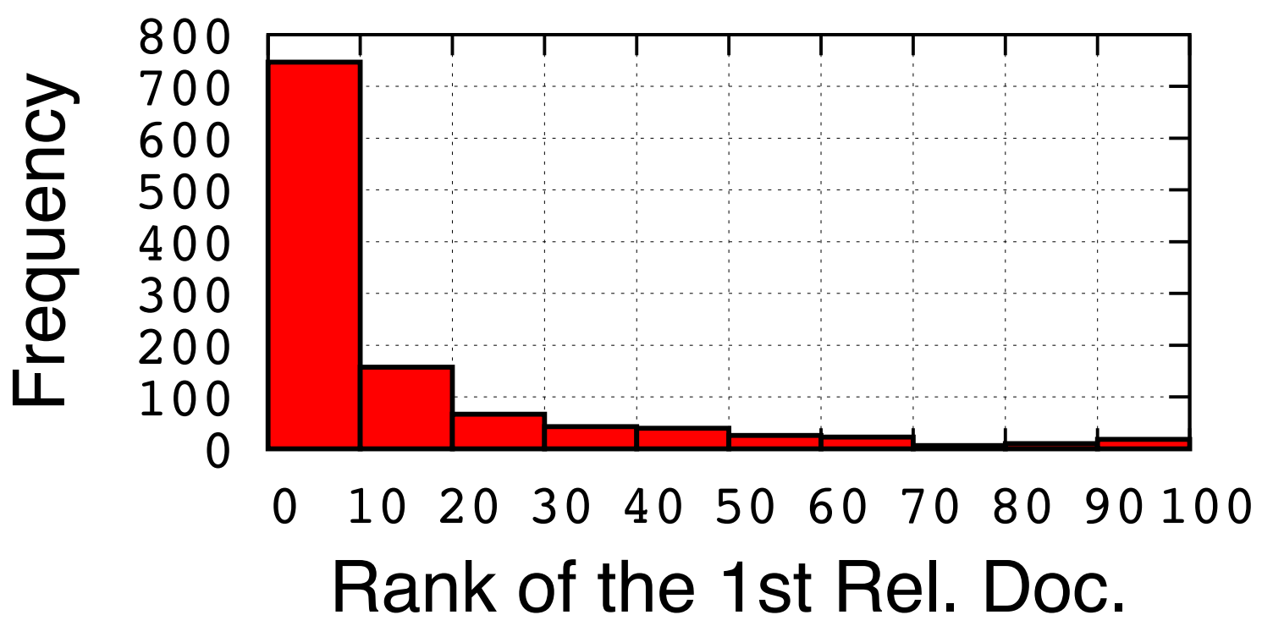


Fig.3: The distribution of the first relevant document rank over test queries.

- Baseline returns first rel. patent
  - ✓ 80% of time in top 10 results,
  - ✓ 90% of time in top 20.
- Minimum user effort

Take Home Message
- **Interactive methods** offer a promising avenue for simple but effective term selection in prior art search.

Acknowledgement

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