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# Literature-Related Discovery (LRD): Introduction and background

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## Abstract

Discovery in science is the generation of novel, interesting, plausible, and intelligible knowledge about the objects of study. Literature-related discovery (LRD) is the linking of two or more literature concepts that have heretofore not been linked (i.e., disjoint), in order to produce novel, interesting, plausible, and intelligible knowledge (i.e., potential discovery). LRD has two main components that differ in their methodological approach to discovery:

- Literature-based discovery (LBD) produces potential discovery through analysis of the technical literature alone.
- Literature-assisted discovery (LAD) produces potential discovery through both analysis of the technical literature and use of selected authors of that literature. These authors generate potential discovery as proposers, workshop/panel participants, or in other active roles.

LRD offers the promise of large amounts of potential discovery, for the following reasons:

- the burgeoning technical literature contains a very large pool of technical concepts in myriad technical areas;
- researchers spend full time trying to cover the literature in their own research fields and are relatively unfamiliar with research in other especially disparate fields of research;
- the large number of technical concepts (and disparate technical concepts) means that many combinations of especially disparate technical concepts exist
- by the laws of probability, some of these combinations will produce novel, interesting, plausible, and intelligible knowledge about the objects of study.

This Special Issue presents the LRD methodology and voluminous discovery results from five problem areas: four medical (treatments for Parkinson's Disease (PD), Multiple Sclerosis (MS), Raynaud's Phenomenon (RP), and Cataracts) and one non-medical (Water Purification (WP)). In particular, the open discovery systems (ODS) aspect of LRD (start with problem, generate potential solution(s), or vice versa) is addressed, rather than the closed discovery

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systems (CDS) aspect (start with problem and potential solution(s), generate linking mechanism(s)). In the presentation of potential discovery, a ‘vetting’ process is used that insures both requirements for ODS LBD are met: concepts are linked that have not been linked previously, and novel, interesting, plausible, and intelligible knowledge is produced.

The potential discoveries for the PD, MS, Cataracts, and WP problems are the first we have seen reported by this ODS LBD approach, and the numbers of potential discoveries for the ODS LBD benchmark RP problem are almost two orders of magnitude greater than those reported in the open literature by any other ODS LBD researcher who has addressed this benchmark RP problem. The WP problem is the first non-medical technical topic to have been addressed successfully by ODS LBD.

In all cases, but especially the medical, we have barely scratched the surface of quantity and quality of potential discovery that could be generated with adequately resourced studies. Based on the many potential discoveries we have obtained, and the promise of far more potential discoveries with adequately resourced studies, we have generated a new paradigm relative to discovery: while the key challenge in traditional discovery is finding a needle-in-a-haystack, the key challenge in ODS LRD (used appropriately) is handling the overwhelming amount of potential discovery available.

Additionally, it is our thesis, as the specific ODS LBD studies will demonstrate, that synergistic combinations of our mainly individual potential discoveries are themselves potential discoveries. We demonstrate throughout this Special Issue the synergistic effects of combining a very few potential discoveries or interesting core literature concepts, and believe that these synergistic benefits are operable at larger scales of combination. In the final lessons-learned paper of this Special Issue, we also show that providing evidence for the synergistic benefits of large numbers of potential discoveries or interesting core concepts is very difficult due to the large numbers of potential combinations involved.

One variant of the LAD operational mode (identifying disparate discipline recipients for Broad Agency Announcement (BAA) notifications in order to stimulate proposals of new ideas from these disparate disciplines) is presented for WP. Other possible applications of LAD include:

1. Recipients of solicitation announcements (other solicitations similar to BAA, journal Special Issue calls for papers, etc),
  2. Participants in Workshops, Advisory Panels, Review Panels, Roadmaps, and War Games,
  3. Points of Contact for Field Science Advisors, Foreign Field Offices, Program Officer site visits, and potential transitions.
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*Keywords:* Discovery; Innovation; Science and technology; Text mining; Literature-based discovery; Literature-assisted discovery; Radical discovery; Innovation; Information retrieval; Unconnected disciplines; Disparate disciplines; Interdisciplinary; Multidisciplinary; Raynaud’s Phenomenon; Cataracts; Parkinson’s Disease; Multiple Sclerosis; Solicitations

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## 1. Introduction

### 1.1. Purpose of Special Issue

This Special Issue presents a comprehensive approach for systematic acceleration of discovery and innovation, and demonstrates the generation of large amounts of potential discovery through five case studies.

### 1.2. Why are discovery and innovation important?

Discovery and innovation are the cornerstones of frontier research. They are the foundation of modern competitive militaries and commercial economies. They allow the technologically advanced nations to remain competitive with the developing nations, which have large well-trained low-cost labor pools.

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