**Writing abstracts**

An abstract is a condensed version of a longer piece of writing that highlights the major points covered, concisely describes the content and scope of the writing, and reviews the writing's contents in abbreviated form. It differs from an introduction, which may outline the structure of a project, but does not include findings or conclusions.

**Key elements that should be included:**

1) Motivation/problem statement: Why do we care about the problem? What practical, scientific, theoretical or artistic gap is your research filling?

2) Methods/procedure/approach: What did you actually do to get your results (What will you do? How?)

3) Results/findings/product: As a result of completing the above procedure, what did you learn/invent/create? (What do you expect to find? What do you hope to accomplish with the project?).

4) Conclusion/implications: What are the larger implications of your findings, especially for the problem/gap identified in step 1? What do the findings mean?

5) Practical implications (if applicable)

What outcomes and implications for practice, applications and consequences are identified? How will the research impact upon the business or enterprise? What changes to practice should be made as a result of this research? What is the commercial or economic impact?

6) Originality/value

What is new in the paper? State the value of the paper and to whom.

**Format**

* An abstract is short and usually written in one paragraph (10-12 lines, 100 to 250 words depending on the requirements; for a 2,000-word piece of writing an abstract of about 100 words would be appropriate.
* It presents information in factual rather than evaluative form; if the subject concerns evaluation, it is still presented neutrally.
* An abstract contains the same terms as the publication.
* Simple tenses and linear sentences are preferable.
* Linking words and phrases are acceptable, albeit used sparingly.
* In most disciplines is does not include bibliographic citations.
* It is advisable to attach in a separate line a list of key terms used in the main body of the document

**Content**

An abstract summarizes the major points of the main document. Depending on the subject, they usually cover:

* The subject
* The context or controversial views on the subject
* Reference to research or study methods (if applicable)
* The main findings

**A typical abstract has the following structure:**

1) introductory statement, including the subject and statement of the problem addressed;

2) research or study methodology or methods of obtaining the answers;

3) findings, results or other main points;

4) concluding statement explaining what the results mean.

**Helpful tips when writing an abstract:**

* Reread your paper with the goal of abstracting in mind.
* Look specifically for these main parts of the paper: purpose, methods, scope, results, conclusions and recommendations.
* After you've finished rereading the paper, write a rough draft without looking back at what you're abstracting.
* Don't merely copy key sentences – you'll put in too much or too little information.
* Don't rely on the way material was phrased – summarize information in a new way.
* Write concisely and clearly. The abstract should reflect only what appears in the original paper.
* Revise your rough draft to:
* Correct weaknesses in organization
* Improve transitions from point to point. Make sure that what you write "flows" properly, that there are "connecting words" (e.g. consequently, moreover, for example, the benefits of this study, as a result, etc.) and/or the points you make are not disjointed but follow on from one another.
* Drop unnecessary information
* Make sure it is complete and accurate
* Eliminate wordiness
* Fix errors in grammar, spelling and punctuation
* Make sure it’s written in the same voice as the paper

**Samples:**

# Fast and Incremental Method for Loop-Closure Detection Using Bags of Visual Words

In robotic applications of visual simultaneous localization and mapping techniques, loop-closure detection and global localization are two issues that require the capacity to recognize a previously visited place from current camera measurements. We present an online method that makes it possible to detect when an image comes from an already perceived scene using local shape and color information. Our approach extends the bag-of-words method used in image classification to incremental conditions and relies on Bayesian filtering to estimate loop-closure probability. We demonstrate the efficiency of our solution by real-time loop-closure detection under strong perceptual aliasing conditions in both indoor and outdoor image sequences taken with a handheld camera.

# Sparse Local Submap Joining Filter for Building Large-Scale Maps

This paper presents a novel local submap joining algorithm for building large-scale feature-based maps: sparse local submap joining filter (SLSJF). The input to the filter is a sequence of local submaps. Each local submap is represented in a coordinate frame defined by the robot pose at which the map is initiated. The local submap state vector consists of the positions of all the local features and the final robot pose within the submap. The output of the filter is a global map containing the global positions of all the features as well as all the robot start/end poses of the local submaps. Use of an extended information filter (EIF) for fusing submaps makes the information matrix associated with SLSJF exactly sparse. The sparse structure together with a novel state vector and covariance submatrix recovery technique makes the SLSJF computationally very efficient. The SLSJF is a canonical and efficient submap joining solution for large-scale simultaneous localization and mapping (SLAM) problems that makes use of consistent local submaps generated by any reliable SLAM algorithm. The effectiveness and efficiency of the new algorithm is verified through computer simulations and experiments.

# Conjunctive Visual Forms

Visual exploration of multidimensional data is a process of isolating and extracting relationships within and between dimensions. Coordinated multiple view approaches are particularly effective for visual exploration because they support precise expression of heterogeneous multidimensional queries using simple interactions. Recent visual analytics research has made significant progress in identifying and understanding patterns of composed views and coordinations that support fast, flexible, and open-ended data exploration. What is missing is formalization of the space of expressible queries in terms of visual representation and interaction. This paper introduces the Conjunctive Visual Form model in which visual exploration consists of interactively-driven sequences of transitions between visual states that correspond to conjunctive normal forms in boolean logic. The model predicts several new and useful ways to extend the space of rapidly expressible queries through addition of simple interactive capabilities to existing compositional patterns. Two recent related visual tools offer a subset of these capabilities, providing a basis for conjecturing about such extensions.

# Harnessing the Web Information Ecosystem with Wiki-based Visualization Dashboards

We describe the design and deployment of Dashiki, a public website where users may collaboratively build visualization dashboards through a combination of a wiki-like syntax and interactive editors. Our goals are to extend existing research on social data analysis into presentation and organization of data from multiple sources, explore new metaphors for these activities, and participate more fully in the web!s information ecology by providing tighter integration with real-time data. To support these goals, our design includes novel and low-barrier mechanisms for editing and layout of dashboard pages and visualizations, connection to data sources, and coordinating interaction between visualizations. In addition to describing these technologies, we provide a preliminary report on the public launch of a prototype based on this design, including a description of the activities of our users derived from observation and interviews.

# Bubble Sets: Revealing Set Relations with Isocontours over Existing Visualizations

While many data sets contain multiple relationships, depicting more than one data relationship within a single visualization is challenging. We introduce Bubble Sets as a visualization technique for data that has both a primary data relation with a semantically significant spatial organization and a significant set membership relation in which members of the same set are not necessarily adjacent in the primary layout. In order to maintain the spatial rights of the primary data relation, we avoid layout adjustment techniques that improve set cluster continuity and density. Instead, we use a continuous, possibly concave, isocontour to delineate set membership, without disrupting the primary layout. Optimizations minimize cluster overlap and provide for calculation of the isocontours at interactive speeds. Case studies show how this technique can be used to indicate multiple sets on a variety of common visualizations.

# Modeling and Optimization in Traffic Flow Management

*New approaches to achieving, assessing, and optimizing safe and efficient management of our ever-growing civil aircraft traffic aim to improve traffic flow and reduce costs.*

Traffic flow management (TFM) allocates the various airport, airspace,and other resources to maintain an efficient traffic flow consistent with safety. TFM is a complex area of research involving the disciplines of operations research, guidance and control, human factors, and software engineering. Hundreds of human operators make TFM decisions that involve tens of thousands of aircraft,en route air traffic control centers, the Federal Aviation Administration's System Command Center, and many airline operation centers. This paper provides an overview of how TFM decisions are made today and challenges facing the system in the future, and reviews modeling and optimization approaches for facilitating system-wide modeling, performance assessments, and system-level optimization of the national airspace system in the presence of both en route and airport capacity constraints.