# Spatial Reasoning Resources Updated July 17, 1998. Links may open in other windows.

Welcome to the list of Online Spatial Reasoning Resources. The original list, created after our [IJCAI-95 Tutorial on Spatial Reasoning.](http://www.cs.albany.edu/~amit/tutijcai.html) became quite popular, and I am now releasing its first major update, with dozens of new sites and updated links and contents for the previous pointers. Except for the first few entries in the list, almost all the entries have new items, so I have not splattered the page with garish NEW signs.

You may also find the [Spatial Reasoning Bibliography](http://www.cs.albany.edu/~amit/bib/spatbib.html) useful, though the web search feature is temporarily off. [Web](http://www.cse.iitk.ac.in/users/amit/other/spatsites.html/search.html) . [is also distributed with the CS bibliography collection maintained by](http://bavi.unice.fr/Biblio/Ai/Spatial.Reasoning.html) [Alf-Christian Achilles](http://liinwww.ira.uka.de/~achilles/), and is widely mirrored at a number of sites.

## Contents

* [Qualitative Spatial Reasoning](http://www.cse.iitk.ac.in/users/amit/other/spatsites.html/spatsites.html#QSR)
* [Quantitative Methods in Geometry, Robotics, and Vision](http://www.cse.iitk.ac.in/users/amit/other/spatsites.html/spatsites.html#QUANT)
* [AI In Design](http://www.cse.iitk.ac.in/users/amit/other/spatsites.html/spatsites.html#DESIGN)
* [Cognitive and Linguistic Aspects](http://www.cse.iitk.ac.in/users/amit/other/spatsites.html/spatsites.html#COGNITIVE)
* [Geographical Information Systems (GIS)](http://www.cse.iitk.ac.in/users/amit/other/spatsites.html/spatsites.html#GIS)

## Qualitative Spatial Reasoning

Qualitative Reasoning uses descriptors like (-,0,+) instead of real numbers to do its work. It is a very useful abstraction in some contexts (e.g. front-left-up discretization), but there are a number of problems such as making indirect inferences, scaling, reasoning about angles, etc. The burgeoning need for understanding spatial abstraction (e.g. in GIS query systems) has boosted the importance of this field.

NOTE: The links below may open in another window.

[SPACENET (Leeds Site)](http://agora.leeds.ac.uk/spacenet/spacenet.html" \t "NEW)

SPACENET or the European Qualitative Spatial Reasoning Network is a multi-university project for studying Spatial Reasoning, distributed over 12 SPACENET sites in Europe. Contains a clickable map with links to these sites. The group at Leeds is headed by [Tony Cohn](http://agora.leeds.ac.uk/spacenet/agc.html), who works on Topological and formal models of space.

[UT QSIM Group](http://www.cs.utexas.edu/users/qr/)

This group is headed by [Ben Kuipers](http://www.cs.utexas.edu/users/kuipers), who has done some of the pioneering work in [spatial reasoning for navigation](http://www.cs.utexas.edu/users/qr/robotics.html). The group currently maintains the QSIM software for qualitative physics simulation, but also does significant amounts of work on reasoning and abstracting spatial aspects of understanding physical phenomena.

[Nishida Lab at Nara, Japan (NAIST).](http://cactus.aist-nara.ac.jp/lab/papers/yamada/english)

This group headed by [Toyoaki Nishida](http://ai-www.aist-nara.ac.jp/doc/people/nishida/home-nishida.html) works on modeling spatial prepositions in the context of natural language understanding, document processing, understanding fluid flow and qualitative function modeling. This group also maintains the [Home page for Qualitative Physics](http://ai-www.aist-nara.ac.jp/doc/qphysics/).

[NCGIA Maine](http://blackbird.spatial.maine.edu/)

The GIS/spatial reasoning group at the Univ. of Maine is headed by [Max Egenhofer](http://www.spatial.maine.edu/~max/SR.html), and works on topological models of spatial reasoning, user interface design, and on query languages, and organized a discussion on [Formal Models of Common Sense Geographic Worlds](http://www.geog.buffalo.edu/ncgia/i21/) along with [David Mark of SUNY Buffalo.](http://www.geog.buffalo.edu/~dmark/research.html) Check out the position statements of [Tony Davis of CYC](http://www-csli.stanford.edu/users/tdavis/geog.html) Also see their [Naive Geography paper.](http://ncgia.geog.buffalo.edu/ncgia/i21/ng/ng.html)

[CMU AI Repository - Qualitative Reasoning Resources](http://www.cs.cmu.edu/afs/cs/project/ai-repository/ai/areas/reasonng/qualittv/0.html)

You can download either Forbus' QPE or Kuipers' QSIM from this site; also in the "Prime Time Freeware for AI" CD.

[Fakultät Informatik, T.U. München](http://papa.informatik.tu-muenchen.de:80/research/kigqsr/)

These lab, headed by Prof. W. Brauer, includes [Daniel Hernández](http://papa.informatik.tu-muenchen.de/mitarbeiter/danher/danher.html), who is part of the Spatial Reasoning. Qualitative Spatial Reasoning issues like representing spatial distances, constraint propagation, and integrating qualitative and Neural Net models.

[University Saarlandes, Saarbrücken](http://zaphod.cs.uni-sb.de/KI/Publist/publist.html)

The AI Lab at Saarbrücken headed by Wolfgang Wahlster has been working for several years on spatial aspects of natural language understanding, in the projects VITRA (VIsual TRAnslator: natural language descriptions for visual scenes), SOCCER (understand scenes from a soccer match), and the recent REAL (Ressource Adaptive Localization). Also maintains a REFER style WEB searchable bibliography.

[EPFL Lausanne AI Laboratory](http://diwww.epfl.ch/w3lia/indexeng.html)

This group is directed by [Boi Faltings](http://liawww.epfl.ch/~faltings/index.html) . Works on qualitative models for device function, kinematics using configuration space, and on spatial reasoning based on algebraic topology.

[IRIT, Toulouse](http://www.irit.fr/ACTIVITES/EQ_LRC/home.uk.html)

The IRIT group at the Université Paul Sabatier and the Université Toulouse addresses natural language analysis from the semantics and logic viewpoint. Focus areas include spatio-temporal reasoning and the relationship between language and perception, including spatio-temporal hybrid reasoning. The project VILAIN (VIsion and LAnguage INtegration) attempts to understand sentences like "the book is on top of the cupboard" in static visual scenes.

[U. Hamburg](http://www.uni-hamburg.de/~ziesche/spacenet/welcome.html)

This group, headed by Christian Freksa, works on diagrammatic reasoning and on integrating the different qualitative spatial reasoning models. Relatively less developed site. You can [see](http://www.cse.iitk.ac.in/users/amit/other/spatsites.html/search.html) Christian Freksa's bibliography as one of the resources at the [Spatial Bibliography site](http://www.cse.iitk.ac.in/users/amit/other/spatsites.html/spatbib.html)

[U.Freiburg](http://www.iig.uni-freiburg.de/cognition/members/cs)

The group at U. Freiburg, headed by Christoph Schlieder. Modeling spade using qualitative models, particularly models that only distinguish left, right and straight turning motions.

[Spatio-Temporal Reasoning Home Page](http://www.cs.auckland.ac.nz/~hans/spacetime/)

This page is maintained by [Hans Guesgen](http://www.cs.auckland.ac.nz/~hans/) at the Univ. Auckland (NZ) and mirrors this page and the SpatBIB bibliography.

[Spatial Interface Metaphors in Hypermedia](http://www.gatech.edu/lcc/idt/Faculty/andreas_dieberger/ECHT94.WS.toc.html)

Online complete proceedings of a workshop on spatial metaphors in virtual user interface design.

[Ohio State](http://www.cis.ohio-state.edu:80/~fz/insight.html) ,

This QR group led by [Feng Zhao](http://www.cis.ohio-state.edu/~fz/), works on [spatial aggregation](http://www.cis.ohio-state.edu:80/~fz/pubs.html).

[I.I.T. Kanpur, India / SUNY Albany](http://www.cs.albany.edu/~amit/refs.html)

[Cognitive Science on the Internet](http://www.cogs.susx.ac.uk/users/ronaldl/list.html) at U.Sussex for an informal list.

[Biological Vision Web Sites](http://www.socsci.uci.edu/cogsci/vision.html)

This is a list of all the groups working in biological models of vision. Also see the [Max Planck Institute](http://www.mpik-tueb.mpg.de/bu.html) for Biological Cybernetics headed by Heinrich H. Bülthoff, and the [Brown University](http://WWW.CS.Yale.EDU/HTML/YALE/CS/AI/TarrLab/tarrlab-top.html) Visual Cognition group headed by Michael Tarr; both these groups investigate cognitive models for linguistic and perceptual issues. The tutorial on [Sensation and Perception](http://www.hanover.edu/psych/Krantz/sen_tut.html) by J.H. Krantz at Hanover College is interesting, with many useful images. ALso of interest is the work on motor imitation in cognitive development by [Merideth Gattis](http://www.mpipf-muenchen.mpg.de/BCD/PEOPLE/GAME/) of the Max Planck Institute for Psychological Research.

[Representational Momentum in spatial cognition](http://www.cse.iitk.ac.in/users/amit/other/spatsites.html/%20http:/dynamic.uoregon.edu/~jjf/rm-rect/)

[Jennifer Freyd](http://dynamic.uoregon.edu/~jjf/) has fascinating results (w/demo) on how an observer's memory for the final position of an abruptly halted object is distorted in the direction of the represented motion.

[Univ. Lund](http://lucs.fil.lu.se/Projects/Conceptual.Spaces/)

This Cognitive Scienct Group, with Peter Grdenfors. works on a geometric model of concept formation.

[Wisconsin Center for Education Research](http://www.wcer.wisc.edu/)

Spatial reasoning for geometry and mathematics learning in Schoolchildren: [How it changes](http://www.wcer.wisc.edu/Projects/Mathematics_and_Science/Modeling_in_Math_and_Science/Newsletters/Look_Change_in_Spatial_Reasonin/newsletter16.html) and [The shape of space](http://www.wcer.wisc.edu/Projects/Mathematics_and_Science/Modeling_in_Math_and_Science/Newsletters/The_Shape_of_Space/newsletter8.html).

[Web-Accessible Linguistic Sources](http://engserve.tamu.edu/files/linguistics/linguist/datasources.html)

Maintained at Texas A&M Univ as part of the [LINGUIST](http://engserve.tamu.edu/files/linguistics/linguist/linguist.html) archives. Also see the [INTERLACE](http://www.aic.nrl.navy.mil/~wauchope/interlace.html) linguistics project at the Navy Research Lab.

[The Whole Brain Atlas](http://www.med.harvard.edu:80/AANLIB/home.html)

## Geographical Information Systems

This is probably the field that needs spatial reasoning more immediately than any other.

[GIS WWW resources](http://www.blm.gov/gis/hotnews.html" \t "NEW)

The US Govt Bureau of Land Management Geospatial Support Staff maintains this page with lots of links to GIS sites including data clearinghouses, utilities, map places, etc.

[ARC/INFO tutorial](http://boris.qub.ac.uk/shane/arc/ARChome.html)

This recent tutorial by Shane Murnion, uses a logging map example and replaces the earlier excellent job by the Kingston U. GIS group (current whereabouts on the web unknown).

[T.U. Vienna, Geoinformation](http://www.geoinfo.tuwien.ac.at/)

This department has a large number of spatial GIS researchers, including [Andrew U. Frank](http://www.geoinfo.tuwien.ac.at/persons/frank.SQR.html), who works on qualitative reasoning about spatial position and on GIS interfaces.

[Spatial Information Research Group, U.Pitt](http://www.pitt.edu/~hirtle/sirg/sirg.html)

This group, headed by [Stephen Hirtle,](http://www.pitt.edu/~hirtle/) works on formal, cognitive and virtual models for spatial reasoning. You can [search](http://www.cse.iitk.ac.in/users/amit/other/spatsites.html/search.html) Stephen Hirtle's bibliography as one of the resources at the [Spatial Bibliography site](http://www.cse.iitk.ac.in/users/amit/other/spatsites.html/spatbib.html)

[U. Manchester Map Semantics Group](http://www.cs.man.ac.uk/ai/oliver/mapsem.html)

Ian Pratt Works on spatial models using [Sinusoidal Transforms](http://www.cs.man.ac.uk/csonly/cstechrep/Abstracts/UMCS-89-8-2.html) and [Oliver Lemon](http://www.cs.man.ac.uk/ai/oliver/home.html) on formal semantics of cartographic representation. See also the [KINDS Home Page](http://cs6400.mcc.ac.uk/kinds/index.html) for improving access to spatial data sets.

[Univ of Glamorgan](http://www.comp.glam.ac.uk/pages/research/gis/)

The Computer Studies Dept has some projects on multiple scales and spatial consistency.

[ERIN GIS - Geographic Information Systems](http://kaos.erin.gov.au/gis/gis.html)

A service from Australia on the environment.

[US Census Online Map Browser](http://tiger.census.gov/cgi-bin/mapbrowse)

The famous TIGER map and street data interface. Includes an online graphical map server reflecting an enormous amount of data, with map resolutions from street level to the entire US, (with intelligent scaling from 1 to 2^13). The [U.S. Census Bureau](http://www.census.gov/) also provides many [Other GIS services](http://www.census.gov/geo/www).

[DeLorme Mapping: Maps in the News](http://www.delorme.com/newsmaps/)

Also see the [interactive hypertext map](http://www.eeb.ele.tue.nl/map/netherlands.html) to graphically browse the provinces of the Netherlands (in dutch).

[U. Laval Geomatics Dept](http://www.gmt.ulaval.ca/homepages/beland/projets_geomatique.html)

This group includes [Geoffrey Edwards](http://www.ulaval.ca/vrr/rech/Cherc/37977.html) (check out this [Geocognostics paper](http://plato.gmt.ulaval.ca/homepages/edwards/Geocognostics.html))and [Christopher Long](http://www.gmt.ulaval.ca/homepages/gold/chris.html), and works on Voronoi Diagrams, remote sensing, image processing, etc.

## AI in Design

It is estimated that 70% of the product cost is locked in by the time a design is entered onto the computer. The stages preceding complete geometry specification, called conceptual design are going to be very important in the coming days. Spatial reasoning problems here include finding similarity between designs (function and shape), defining shapes ambiguously as in conceptual sketching, defining shape classes as opposed to single shapes (already possible - parametric design), etc.

[WPI AIDG -- AI in Design Webliography](http://cs.wpi.edu/Research/aidg/AIinD-hotlist.html" \t "NEW)

A web-list for AI in Design sites.

[WWW Virtual Library: Design](http://www.dh.umu.se/vlib.html)

Art and Design universities and sites.

[BEST Lab, Berkeley](http://hart.me.berkeley.edu/)

Headed by [Alice Agogino](http://hart.me.berkeley.edu/~best/abstracts.index.html). Works on design at the conceptual level and on modeling spatial reasoning and [visualization skills](http://hart.me.berkeley.edu/~best/abstracts5.html) in engineers. Also see these [design case studies.](http://www1.needs.org/develop)

[Stanford Center for Design Research (CDR)](http://cdr.stanford.edu/)

Also check out the [Stanford KSL](http://ksl.stanford.edu/) for Qualitative Reasoning about Function, the [Ontolingua](http://www-ksl.stanford.edu/knowledge-sharing/ontolingua/ontolingua.html) project, the MADEFAST collaborative design project, and the online interactive [Ontology Editor](http://www-ksl-svc.stanford.edu:5915/FRAME-EDITOR).

[Virtual Design, Georgia Tech](http://www.cc.gatech.edu/gvu/virtual/CDS/)

The Conceptual Design Space (CDS) is an interactive virtual environment that focuses on immersive 3D design using innovative virtual world tools. Other 3D work includes [stereoscopic imagery](http://www.tisco.com/3d-web/index.html) for 3D effects.

[Univ. Marseille](http://lieu.univ-mrs.fr/LIM/LOGIQUE/publisD.html)

The CASSINI group, with Jeansoulin Robert, works on Spatial Logics for GIS applications and image processing.

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