

Curriculum Vitae

Prof. Mauro Negri (last update 27/06/2019)

Personal information

Name: Mauro Negri
Date of birth: 25/11/1955
Nationality: Italian

Currently working at:

Dipartimento di Elettronica, Informazione e Bioingegneria (D.E.I.B.)
Politecnico di Milano,
Piazza Leonardo da Vinci, 32
20132 Milan, Italy
Phone: +39 0223993654
email: mauro.negri@polimi.it

Position and education

1983 - 1986

technical chief of the Data Processing Centre of D.E.I.B.

1986 - 1992

Research Assistant in Computer Engineering at the Engineering Faculty of the University of Brescia, Italy.

1992 – present

Associate Professor in Computer Engineering at the School of Industrial and Information Engineering, Politecnico of Milan, Italy

1993 – 1999

President of the user conference for the student area of the Administrative Data Processing Centre (C.E.D.A.) of Politecnico Milano and member of the Board of Directors of C.E.D.A.

Education

Laurea in Electronic Engineering, December 1979, at the Engineering Faculty - Politecnico di Milano (Italy). Grade 100/100.

Teaching activity

1986 – 1992.

Principal Lecturer of computer programming courses at University of Brescia - Undergraduate level.

1992 - present.

Principal lecturer of computer programming and spatial databases courses at Politecnico di Milano - Undergraduate level.

International research projects.

M. Negri participated actively as a member in the following research projects:

- 1988 - 1989 COMANDOS: Integration of heterogeneous databases through object oriented techniques, project type: EU-ESPRIT, Funding: EU.
- 1999 - 2000 Base de donnees et cartographie de la biodiversité, project type: Interreg IIC, Funding: EU.

- 2008 - 2009 Integration, harmonization and sharing of U.E. addresses, subproject: definiton of the data model and production of the GML datasets, project type: EU Euradin, Funding: UE INSPIRE.
- 2007 - 2013 A technological alpine platform for sharing data in a federated database, project type: INTERREG ITA-CH - PROGETTO STRATEGICO PTA, Funding: EU.

Italian research projects

M. Negri contributed actively in the following multidisciplinary research projects:

- 1981 Informatizzazione della Pubblica Amministrazione, subproject P2, target DATAID and DATANET, project type Progetto Finalizzato CNR, Funding: CNR.
- 1988. Sistemi informatici e calcolo parallelo, subproject 5: Sistemi evoluti per basi di dati, target "Basi di dati orientate ad oggetti", topic "Interazione con basi di dati eterogenee e multimedia", project type Progetto Finalizzato CNR, Funding: CNR.
- 1996 Definition of the cartografia tematica lombarda, project type: P.A. project, Funding: Fondazione Lombardia per l'ambiente della Regione Lombardia.
- 1997 Specifica di applicazioni per basi di dati su Internet e Intranet, metodologie di progettazione di siti WWW , projecy type: PRIN, Funding: MIUR.
- 2003 - 2006 IntesaGIS: Intesa Stato-Regioni-Enti locali sui sistemi informativi territoriali, Working Group 01: Design of the conceptual model and schema of the database topografici di interesse generale, project type: P.A. project, Funding: Regioni Italiane.
- 2006 - 2013 Several projects dealing with different technological aspects of the realization of a National Spatial Data Infrastructure and of the interoperability among Italian Public Administrations at different local and national level, project type: P.A. project, some funding agencies: Regione Lombardia (DG Public Utilities, D.G. Territorio e Urbanistica), Regione Piemonte, Regione Veneto, Provincia di Milano, Provincia di Sondrio, Cremona municipality). Amount of funding: more than 600.000 euros.

Technology transfer projects

M. Negri has been project leader in the following projects (co-leader has been Prof. G.Pelagatti):

- 2009 - present. Specifiche tecniche nazionali per i database topografici e sviluppo di strumenti di supporto al progetto e validazione di dataset conformi, project type: P.A. (Public Administration) project, Funding: CISIS (Centro Interregionale per i Sistemi informatici, geografici e statistici. Amount of funding: about 500.000 euros.
- 2014 – 2017. Development of an architecture for integrating the Italian spatial data infrastructure in the European spatial data infrastructure as required by the EU directive INSPIRE for the spatial data interoperability in Europe. Project type: P.A. project, Funding: CISIS (Centro Interregionale per i Sistemi informatici, geografici e statistici. Amount of funding: about 100.000 euros.

Minor projects

Representative of the Politecnico Milano in the following projects:

- 2002. Integrated interventions in high schools, universities and businesses in Milan for the development of strategic skills required by the university and the world of work. Working group "Computer science", Funding: UE – FSE.
- 2003. Definition of the computer science curricula and skills required to the students of secondary schools, Funding: MIUR and AICA.

Workshop organization

- 2003 Organizer of the workshop "International Meeting on Technology for a National Geodatabase Infrastructure", 4-5 September, Siena, Italy.

Research activity

A brief resume of the past researches (1980 – 2006)

The researches were mainly focused on database management systems, dealing with open problems related to network, relational and object oriented database technologies and models.

In particular, the following topics have been investigated:

Network Codasyl databases:

- Separating logical and physical design of Codasyl databases in order to obtain a physical data independence. The research has defined a reference physical data model and the related Storage Schema Definition Language [JR.1, NC.1]

Distributed databases

- Definition of a model for partitioning data on different nodes of a distributed database, and the architecture of a system, called DATANET/HERMES, for the management of the local databases in distributed DBMSs [IC.1, NC.2, NC.3]

Relational databases

- Formalization of the semantics of SQL using a 3-valued logic interpretation [JR.6] and identification of the drawbacks in the interpretation of universal quantification in SQL [JR.4].
- Improvement of existing evaluation algorithms for join queries [JR.2] and developing of a new algorithm for join evaluation [JR.5].

Integration of heterogeneous databases

- Integration of Codasyl and relational databases through the realization of a relational interface on top of Codasyl databases [IC.2].
- Integration of data sources without a model (flat files) or databases having different data models (relational and object oriented) and stored on different technologies through an object orientation (OO) approach. The research has defined a unifying OO data model as an interface of different local data sources and has designed how implement the interface in terms of operations on the local systems [JR.3, JR.9, IB.1, IC.3, IC.4, IC.5].
- The use of an OO approach in integrating data has suggested a depth investigation of the main characteristics of an OO data definition and manipulation language [JR.8].

Integrating data inside documents

- How to include the result of an SQL query in a document adapting the text to some of the data characteristics (e.g., gender, number,...) [JR.7].

Modelling spatio-temporal data

- Definition of a spatial logical data model and algebra for the logical design of spatial database schemas through the analysis of logical models of existing technologies in order to define a common reference model [IC.7, IC.8, NC.4].
- Extension of the Entity Relationship data model in order to deal with conceptual spatial data and constraints. This model has been experimented in several projects for designing the spatial database of "Regione Lombardia" [IC.6] and of several other public administrations [NC.5, NC.6, NC.7, NC.8, NB.1, NB.2].
- Management of the transactional time component of a spatial dataset and proposal of an approach to store the history of the changes of the spatial data. The adopted approach captures changes storing snapshots of each updated area instead of attaching historical changes to each spatial object [JR.10, IC.9].
- Spatial constraints driven updates. Spatial integrity constraints on spatial data are explored in order to embed them in the implementation of database updates; in particular, spatial integrity constraints to preserve topological relationships among spatial data are considered [IC.10].
- Management of spatial updates on data at different levels of accuracy. A new approach in which updates with a higher level of accuracy are applied to a spatial database increasing the accuracy of the whole spatial database; the approach has been defined maintaining the topological relationships and shape properties of the spatial database [IC.13].

Recent research activity (2006 – present)

The research has been focused on four different aspects of the management of spatial data: the main topic was the definition of a methodology and of related software tools for supporting the design of spatial database. Other aspects were the exploration of spatial data interoperability in distributed Spatial Data Infrastructures (SDIs), an in depth investigation of the robustness of computational geometry algorithms and the optimization of spatial queries on big spatial data.

The approach used in these researches was twofold: to research innovative solutions and applying them to the real problems of the Italian Public Administrations, in order to verify the effectiveness of the research results. For this reason, the development of the researches was strictly integrated with their experimentations.

GeoUML methodology

- The first problem was the definition of a conceptual data model, called in the sequel "GeoUML" for the conceptual design of spatial databases. The

main contribution of GeoUML was the modelling of the spatial constraints based on the topological and whole-part relationships existing among spatial data; in particular, the research has defined a predefined set of spatial constraints and their formalization in terms of OCL expressions of the UML data model. This model was developed as an extension of the UML, which is compliant with the OGC (OpenGeospatial consortium), standards, the ISO/TC211-19100 standard series and the European CEN/TC287 standards [JR.11, IC.11, IC.14, NC.9, NC.10].

A first version of the GeoUML data model has been approved as an Italian reference standard (2007) by CNIPA (now AGID) Italian authority and used in the National "Intesa GIS" project; it allowed the definition of the conceptual schema of National geo-topographic databases [TS.1, TS.2]. A series of National projects funded by CISIS (Centro Interregionale per i Sistemi informatici, geografici e statistici) tested and improved the data model and supported the definition of a new version of the GeoUML data model. In 2012, this new version has been approved as an Italian technical standard for the design of geo-topographic databases at National and Local administration levels and it has been published as a technical annex of a decree of the Italian government [TS.3].

A case tool called, "GeoUML Catalogue", and based on the GeoUML data model has been designed and implemented [SW.1]. It has been extensively used for the conceptual description of data and related spatial constraints and for designing the underlying logical data structures on spatial SQL technologies (ad es., Postgis, Oracle) and on transferring interchange data formats (shape and GML files).

- Another topic was the automatic validation of topological constraints on spatial data. It has been individuated an approach based on predefined SQL script templates designed for each kind of topological constraint which are automatically generated and specialized on a specific spatial constraint existing in a spatial database. The above idea and some related problems have been studied in [IC.17, IC.18, IC.19]. The approach has been adopted in the design and implementation of the GeoUMLvalidator tool [SW.2]. GeoUMLvalidator is a software tool, which reads the conceptual schema of data, the related spatial constraints and the mapping on the underlying technology (created by GeoUMLcatalogue) and performs a structural validation of data (correctness of each spatial and traditional value, object identification, referential integrity constraints,...) and the validation of the topological constraints over spatial data. Actually, this tool is widely used in public administrations in order to evaluate the conformance of spatial datasets to their conceptual description. Details of the methodology and of the tools are available on spatialdbgroup.polimi.it.
- Further extensions of the GeoUML data model in order to deal with a full 3D model have been investigated; in [IC 26] has been considered the CityGML approach for modeling 3D surfaces and volumes and their topological relationships.

Development of Spatial Data Infrastructures (SDI)

The availability of SQL technologies for spatial data has enabled the development of National Spatial data infrastructures, however, SDI require a complex management since the responsibility is distributed over several Public administrations. Moreover, each UE country has developed its own SDI without a common European framework; the lack of a definition of common shared data and of the harmonization at the country boundaries limits data interoperability. The UE directive INSPIRE has defined common conceptual schemas (data specifications) as UML class diagrams and gml-XSD in order to provide Web Feature Services, but several difficulties arise in their implementation in the different countries. In this context, the following topics have been investigated:

- The problem of owner responsibility in updating spatial data in a highly coupled SDI in order to guarantee a safe update of data and the integration of spatial data shared among different owners in adjacent areas [IC.15]. A particular case of integration between linear spatial data (eg, road_elements of a road network) and their segmented properties (e.g., number of lanes in road elements) has been studied; the problem of the integration of these two inter-related spatial data is addressed, considering different implementation models of segmented properties and different ownerships [IC.16];
- Workflow in SDI. It is investigated the applicability of emerging workflow technologies for developing GIS distributed applications. Some limits are highlighted and some improvements are suggested in [IC.20].
- Spatial data interoperability. The INSPIRE UE directive requires to expose the content of National SDIs using the INSPIRE data specifications described through the INSPIRE data model (IDM) and to provide data through web services or gml files according to INSPIRE XSD schemas. A first approach to this problem was based on the use of the GeoUML data model and the GeoUMLcatalogue to describe the European INSPIRE data specifications [IC.22], but GeoUML has shown some limitations in describing the concepts of the INSPIRE data model (e.g., nested and hierarchical datatypes). Therefore, two different approaches to the interoperability of National and INSPIRE datasets have been investigated: the first one is based on the idea of extracting data from National datasets as gml files and transforming them to gml files according to European XSDs through XSL transformations [IC12]. A second approach is based on the use of SQL technology; the generation of gml files is divided in two steps: in the first step SQL based scripts transform and load the content of a National spatial database in an INSPIRE SQL database; the second step exposes the content of the INSPIRE database in GML format [IC24], configurating WFS services. In particular, the first step is further divided in two different mappings: first, the source dataset is automatically redefined in terms of the INSPIRE data

model and then the semantic transformations of data are executed in a common data model. The complex task of the semantic transformation is driven by transformation rules manually defined and is implemented through automatic SQL procedures. In order to show the feasibility of the proposed approach two software tools have been designed and implemented. A first case tool, called "IDMB" [IC.25, SW.3] (details on spatialdbgroup.polimi.it) has been designed and implemented to allow the building of the INSPIRE SQL database starting from the INSPIRE conceptual specifications and the configuration of WFS services.

A more complex tool, called "IDMT" based on the integration of the GeoUMLcatalogue, the IDMB functionalities and on a semantic transformer has been implemented [SW.4]; this tool is being experimented in some public administrations with the support of CISIS.

Robustness in the evaluation of topological relationships

The evaluation of topological relationships on real spatial data can produce different results in different systems and this is due to the discrete FP (IEEE754) representation of real numbers adopted by the systems and to the perturbations introduced by the exchange of data between different systems.

- The research has investigated how to improve the robustness of the evaluation of the topological relationships on spatial data through the definition of identity and minimum distance rules that applied to a dataset allow a non-ambiguous evaluation of the relationships [IC.21]. The same problem has been addressed using an implementation approach based on the tolerance in the equality evaluation among coordinates [IC.23], [JR.13], [JR.15].
- The above studies have allowed the definition of a new algorithm called Snap Rounding with Restore (SRR), which aims to make geometric datasets robust and to increase the quality of geometric approximation and the preservation of topological structures [JR.14]. It improves the existing algorithms under the viewpoint of the distance from the original segments and of the conservation of their topological structure.

Spatial query processing and optimization

- This research topic deals with the study of new approaches for the specification of spatial queries in geographical applications and the techniques for their execution and optimization. Although the GeoUML validator checks topological constraints using threads to parallelize the execution, the performance get worse when the quality requirements on spatial data increase and the size of spatial datasets grows. For this reasons a new execution model based on a cluster architecture has been studied. In [IC.27] the validation of topological constraints was experimented using Spatial Hadoop in which SQL queries has been translated into Pigeon scripts and map-reduce programs and data are distributed on a cluster of computers. Another aspect regards the partitioning of spatial data on a cluster when spatial data are big in

extension. A new approach based on the splitting of big geometries into smaller parts, the evaluation of the algorithms on the parts and the rebuilding of the result for big geometries starting from the result on the parts has been addressed in [IC.28].

Complete list of publications and software tools
Prof. Mauro Negri (last update 27/6/2019)

International journals

- JR.1* M.Negri, R.Zicari, "A Storage Structure Definition Language for Codasyl databases", Information Systems, vol. 9, n. 1, pp. 59-68, Pergamon Press (GB), 1984, reviewed also in Computing Reviews August 1985.
- JR.2* M.Negri, G.Pelagatti, "Join during merge: an improved sort based algorithm", Information Processing Letters, vol. 21, pp. 11-16, North Holland (NL), 1985.
- JR.3* E.Bertino, M.Negri, G.Pelagatti, L.Sbattella "Integration of Heterogeneous Database applications through an object-oriented interface", Information Systems, Vol. 14, n.5, pp. 407-420, Pergamon Press (GB), 1989.
- JR.4* M.Negri, G.Pelagatti, L.Sbattella, "Semantics and problems of Universal Quantification in SQL", The Computer Journal, Vol. 32, N. 1, pp. 90-91, Cambridge Univ. Press (GB), 1989.
- JR.5* M.Negri, G.Pelagatti, "Distributive join: a new algorithm for joining relations", ACM Transactions on Database Systems (TODS), Vol.16, n.4, pp.655-669, 1991, reviewed also in Computing Reviews August 1992.
- JR.6* M.Negri, G.Pelagatti, L.Sbattella, "Formal semantics of SQL queries", ACM Transactions on Database Systems (TODS), Vol.16, n.3, pp. 513-534, 1991, reviewed also in Computing Reviews August 1992
- JR.7* M.Negri, G.Pelagatti, L.Sbattella, "Adapting text to data in documents through a natural language processor", Information Systems, Vol.16, n.1, pp.35-47, Pergamon Press (GB), 1991.
- JR.8* E.Bertino, M. Negri, G. Pelagatti, L. Sbattella, "Object oriented Query Languages: the Notion and the Issues", IEEE Transactions on Knowledge and Data Engineering, Vol.4, N.3, pp. 223-237, 1992.
- JR.9* E.Bertino, M.Negri, G.Pelagatti, L.Sbattella, "Applications of Object Oriented Technology to the Integration of Heterogeneous Database Systems", Distributed and Parallel databases: An International Journal, Vol.2, N.4, pp. 343-370, Kluwer Academic Publishers, 1994.
- JR.10* A. Belussi, M. Negri, G. Pelagatti, "Management of data changes in GeoDatabases: Time component in GIS", GIM International, Vol.13, N.7, pp.41-43, GITC Netherlands, 1999.
- JR.11* A. Belussi, M. Negri, G. Pelagatti "Modelling Spatial Whole-Part Relationships using an ISO-TC211 conformant approach", Information and software technology, Elsevier, vol. 48, n.11, pp. 1095-1103, 2006.
- JR.12* S. Ceri, C. Bolchini, D. Braga, M. Brambilla, A. Campi, S. Comai, P. Fraternali, P. Lanzi, M. Masseroli, M. Matera, M. Negri, G. Pelagatti, G. Pozzi, E. Quintarelli, F.A. Schreiber, L. Tanca, "Data and Web Management Research at Politecnico di Milano", SIGMOD RECORD, vol.36, n.4, pp. 43-48, 2007.
- JR.13* A. Belussi, S. Migliorini, M. Negri, G. Pelagatti, "Impact of Data Representation Rules on the Robustness of Topological Relation Evaluation", Geoinformatica, Kluwer Academic Publishers, ISSN: 1384-6175, vol. 19, n. 2, pp. 185-226, 2015.
- JR.14* A. Belussi, S. Migliorini, M. Negri, G. Pelagatti, "Snap Rounding with Restore: an Algorithm for Producing Robust Geometric Datasets", ACM Transactions on spatial algorithms and systems, ISSN: 2374-0353, vol.2, n.1, pp. 1-36, 2016

JR.15 A. Belussi, S. Migliorini, M. Negri, G. Pelagatti, "Establishing Robustness of a Spatial Dataset in a Tolerance-Based Vector Model", Transactions in GIS, ISSN: 1361-1682, John Wiley & sons, vol.21, n.4, pp.722-747, 2017

Chapters in international books

IB.1 E.Bertino, M.Negri, L.Sbattella, "An overview of the Comandos Integration System", chapter in Object Oriented Multidatabase Systems: A solution for advanced applications, editor O.Bukhres, A.K. Elmagarmid, pp. 379-422, Prentice Hall, 1996.

International conferences

IC.1 S.Ceri, M.Negri, G.Pelagatti, "Horizontal data partitioning in database design", Proc. ACM SIGMOD International Conference on Management of Data, pp. 128-136, 2-4 June 1982, Orlando, Florida (USA).

IC.2 V.D'Apollonio, A.Fuggetta, P.Lazzarini, M.Negri, G.Pelagatti "The integration of the network and relational approaches in a DBMS", Proc. Fourth British National Conference on Databases BNCOD-4, pp. 177-197, 10-12 July 1985, Keele, England.

IC.3 E.Bertino, R.Gagliardi, M.Negri, G.Pelagatti,, L.Sbattella, "The COMANDOS Integration System: An Object Oriented Approach to the Interconnection of Heterogeneous Applications", Proc. 2nd Int. Workshop on Object Oriented Database Systems, pp. 213-218, 27-30 September 1988, Bad Munster FRG.

IC.4 E.Bertino, M.Negri, G.Pelagatti, L.Sbattella, "An Object-Oriented Approach to the Interconnection of Heterogeneous Databases", Proc. Int. Workshop on Heterogeneous Databases, 11-13 December 1989, Evanston, IL.

IC.5 E.Bertino, M.Negri, G.Pelagatti, L.Sbattella, "An Object-Oriented Data Model for Distributed Office Applications", Proc. Conference on Office Information Systems, pp. 1-11, 25-27 April 1990, Cambridge, MA (USA).

IC.6 A.Belussi, M.Negri, G.Pelagatti, M.Rossi, L.Sbattella," Design and Implementation of a Geographic Information System: the case of Regione Lombardia", Proc. 2nd European Conference on Geographical Information Systems, pp.856-865, 1991, Brussels, Belgium.

IC.7 A.Belussi, M.Negri, G.Pelagatti, "A conceptual framework for understanding the ARC/INFO data model and operations", Proc. 4th European Conference on Geographical Information Systems, pp.1431-1439, 1993, Genova (Italy).

IC.8 A.Belussi, M.Negri, G.Pelagatti, F.Liguori, "Designing and evaluating database schemas for ARC/INFO applications", Proc. 5th European Conference on Geographical Information Systems, pp.1169-1185, 1 march 1994 Paris, France.

IC.9 A.Belussi, M.Negri, G.Pelagatti, G.Zuliani, "Representing the temporal evolution of spatial data in GIS", Proc. 21st UDMS, pp. 6.1-6.8, 21-23 April 1999, Venezia (Italy).

IC.10 A.Belussi, M.Negri, G.Pelagatti, F. Spinazza, "An integrity constraints driven system for updating spatial databases", International symposium on Advances in geographic information systems, ACM New York, NY, Proc. 8th ACM GIS", pp. 121-128, 10-11 November 2000, Washington D. C: (USA).

IC.11 A.Belussi, M.Negri, G.Pelagatti, "GeoUML: a Geographic Conceptual Model defined through specialization of ISO TC 211 standards, Proc. 10th EC GI & GIS workshop, ESDI: state of the art, pp.1-10, 23-25 June 2004, Varsaw, Poland.

IC.12 A.Belussi, M.Negri, G.Pelagatti, Mapping IntesaGIS to the EuroRoads model, ESDI Workshop on conceptual schema, languages and tools, 12-14 October 2005, JRC Ispra, Italy.

- IC.13 A.Belussi, M.A.Brovelli, M.Negri, G.Pelagatti, F. Sansò, "Dealing with Multiple Accuracy Levels in Spatial Databases with Continuous Update", Atti di 7th International Symposium on Spatial Accuracy Assessment in Natural Resources and Environmental Sciences (Spatial Accuracy 2006)", pp.203-212, Lisbon, Portugal, 5-7 July 2006.
- IC.14 A.Belussi, M.Negri, G.Pelagatti, "An ISO TC 211 Conformant Approach to Model Spatial Integrity Constraints in the Conceptual Design of Geographical Databases", Advances in Conceptual Modeling – Theory and Practice, Lecture Notes in Computer Science n. 4231, editor J.F. Roddick et al., Berlin/Heidelberg, Springer, Proc. ER 2006 (CoMoGIS workshop), pp. 100-109, 6-9 November 2006, Tucson, AZ (USA).
- IC.15 A.Belussi, F.Liguori, J.Marca, M.Negri, G.Pelagatti, "Ownership definition and instances integration in highly coupled Spatial Data Infrastructures", in *highly coupled Spatial Data Infrastructures* The European Information Society – Taking Geoinformation Science One step further, Lecture Notes in Geoinformation and Cartography editor Lars Bernard et. al., Berlin - Heidelberg, Springer, Proc. 11th AGILE 2008 conference, pp.379-399, 5-8 May, 2008, Girona, Spain.
- IC.16 A. Belussi, F. Liguori, J. Marca, S. Migliorini, M. Negri, G. Pelagatti, P. Visentini, "Transferring Segmented Properties in the Conflation of Transportation Networks" in Advances in GIScience, Lecture Notes in Geoinformation and Cartography, editor M. Sester, L. Bernard and V. Paelke, Springer, Proc. AGILE 2009, pp.195-215, 2-5 June 2009, Hannover, Germany.
- IC.17 A.Belussi, S.Migliorini, M.Negri, G.Pelagatti, "From the Conceptual Design of Spatial Constraints to their Implementation in Real Systems", Proc. 17th ACM SIGSPATIAL International Conference on Advances in GIS (ACM GIS), pp. 448-451, 4-6 November 2009, Seattle, Washington (USA).
- IC.18 A.Belussi, S.Migliorini, M.Negri, G.Pelagatti, "Managing Collapsed Surfaces in Spatial Constraints Validation", in Geospatial Thinking, Lecture Notes in Geoinformation and Cartography editor M. Painho, M.Y. Santos and H. Pundt, Springer, Proc. 13th AGILE International Conference on Geographic Information Science, pp. 259-278, 11-14 May 2010, Guimarães, Portugal.
- IC.19 A.Belussi, F.Liguori, S.Migliorini, J.Marca, M.Negri, G.Pelagatti, P.Visentini, "Validation of Geographical Datasets against Spatial Constraints at Conceptual Level", Proc. 28th Urban Data Management Symposium (UDMS 2011)", pp. 89-93, 28-30 September 2011, Delft, The Netherlands. in the series «THE INTERNATIONAL ARCHIVES OF THE PHOTOGRAMMETRY, REMOTE SENSING AND SPATIAL INFORMATION SCIENCES» vol. XXXVIII n. 4/C21, ISSN 1682-1777.
- IC.20 A.Belussi, M.Gambini, S.Migliorini, M.Negri, G.Pelagatti, "Workflow Technology for Geo-Processing: The Missing Link", Proc. 2nd International Conference on Computing for Geospatial Research & Application (COM.Geo '11), ISBN 9781450306812, pp.1-6, 23-25 May 2011, Washington, DC, USA.
- IC.21 A.Belussi, S.Migliorini, M.Negri, G.Pelagatti, "Robustness of Spatial Relation Evaluation in Data Exchange", Proc. 20th ACM SIGSPATIAL International Conference on Advances in GIS, ISBN 9781450316910, pp. 446-449, 6-9 November 2012, Redondo Beach, California, USA.
- IC.22 A.Belussi, J.Marca, M.Negri, G.Pelagatti, "Application of the GeoUML tools for the production and validation of Inspire datasets", Proc. INSPIRE 2013: the green renaissance, pp.1-2, 23-27 May 2013, Firenze, Italy.
- IC.23 A.Belussi, S.Migliorini, M.Negri, G.Pelagatti, "On Robust Interpretation of Topological Relations in Identity and Tolerance Models", Proc. 21st ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems (ACM GIS), ISBN 9781450325219, pp. 478-481, 5-8 November 2013, Orlando, Florida, USA.

- IC.24* A.Belussi, P.Cipriano, S.Migliorini, M.Negri, G.Pelagatti, "Design of the Data Transformation Architecture for the INSPIRE Data Model Browser in Connecting a Digital Europe through Location and Place", Proc. AGILE'2014 International Conference on Geographic Information Science, ISBN: 9789081696043, pp.1-2, 3-6 June 2014, Castellón, Spain.
- IC.25* A.Belussi, M.Negri, G.Pelagatti, "IDMB: a Tool for Navigating the INSPIRE Data Model and Generating an INSPIRE SQL Database and WFS Configuration", Proc. INSPIRE Conference, pp. 1-2, 18-20 June 2014, Aalborg, Denmark.
- IC.26* A.Belussi, S.Migliorini, M.Negri, G.Pelagatti, "Validation of spatial integrity constraints in city models", Proc. 4th ACM SIGSPATIAL International Workshop on Mobile Geographic Information Systems, ISBN 9781450339773, pp. 70-79, 3-6 November 2015, Seattle, Washington, USA.
- IC.27* A.Belussi, S.Migliorini, M.Negri, G.Pelagatti, "Towards massive spatial data validation with SpatialHadoop", Proc. 5th ACM SIGSPATIAL International Workshop on Analytics for Big Geospatial Data (BigSpatial '16), ISBN 978-1-4503-4581-1, pp.18-27, 31 October 2016, Burlingame, California, USA.
- IC.28* A.Belussi, D. Carra, S.Migliorini, M.Negri, G.Pelagatti, "What Makes Spatial Data Big? A Discussion on How to Partition Spatial Data", Proc. 10th International Conference on Geographic Information Science (GIScience 2018), LEIBNIZ INTERNATIONAL PROCEEDINGS IN INFORMATICS series, ISBN 978-3-95977-083-5, Vol. 114, pp.1-15, 28-21 august 2018, Melbourne, Australia.

National conferences

- NC.1* M.Negri, R.Zicari, "Un modello ed un linguaggio per la definizione delle strutture di memorizzazione in basi di dati reticolari", Proc. Italian Conf. AICA, pp. 1663-1673, 29/9 – 3/10 1980, Bologna, Italy.
- NC.2* M.Negri et al., "Datenet/Hermes: un sistema per la gestione di basi di dati distribuite", Proc. Italian Conf. AICA, pp. 1269-1281, 23-25 September 1981, Pavia, Italy.
- NC.3* S.Ceri, M.Negri, G.Oldano, P.Paolini e G.Pelagatti, "The run time control machine of the Hermes/1 distributed database system", Proc. Giornata di studio su Basi dati distribuite e automazione dell'ufficio, pp.7-41, 3 November 1983, Firenze, Italy.
- NC.4* A.Belussi, M.Negri, G.Pelagatti, "Spatial Relational Algebra: an extended relational algebra for spatial databases", Proc. Italian Conf. on Sistemi Evoluti per Basi di Dati, pp. 91-110, 3-5 July 1996, San Miniato, Italy.
- NC.5* C.Margiocco, M.G.Mariotti, M.Negri, "Un sistema informativo per la tutela del patrimonio naturale della Regione Lombardia", Proc. 3rd Italian Conf. ASITA, Vol. II, pp.899-904, 9-12 November 1999, Napoli, Italy.
- NC.6* S. Bocchi, M. Negri, L. Bechini, F. Spinazza, I. Zanichelli, "Il sistema informativo territoriale per il Parco Sud Milano", Proc. 4th Italian Conf. ASITA, pp.465-470, 3-6 October 2000, Genova, Italy
- NC.7* M.Brogli, M.Negri, F.Spinazza "Il sistema informativo territoriale della provincia di Milano: stato attuale e sviluppi" Proc. 5th Italian Conf. ASITA, Vol. I, pp.305-310, 9-12 October 2001, Rimini, Italy.
- NC.8* M.Brogli, M.Negri, F.Spinazza "Dai file ai database: evoluzione tecnologica o premessa per l'e-government? L'esperienza del SIT della provincia di Milano", Proc. 6th Italian Conf. ASITA, Vol. I, pp. 529-534, 5-8 November 2002, Perugia, Italy.
- NC.9* A.Belussi, M.Negri, G.Pelagatti, "Problemi di applicazione degli standard ISO TC 211 alla modellazione di una base dati spaziale", Proc. 8th Italian Conf. ASITA: geomatica, pp.363-368, 2004, Roma, Italy.
- NC.10* M.Negri, M.Brogli, "Applicabilità del modello GeoUML del progetto Intesa-GIS nel SIT della provincia di Milano", Proc. 8th Italian Conf. ASITA: geomatica, pp.1553-1558, 2004, Roma, Italy.

- NC.11 D. Dal Puppo, R. Laffi, S. Gelmi, M. Panebianco, F. Guzzetti, N. Negri, G. Pelagatti, F. Liguori "Coordinamento e cooperazione con gli enti locali per la realizzazione del data base topografico in Regione Lombardia", Proc. 12th Italian Conf. ASITA, pp.951-956, 21 - 24 October 2008, L'Aquila, Italy.
- NC.12 A. Belussi, M. Negri, "Controllo qualità dei dati e interoperabilità in aggiornamento", Proc. 15th Italian Conf. ASITA, pp. 1-7, 15-18 November 2011, Reggio di Colorno, Italy.

Technical contribution in regional and national laws.

This section lists regional and national laws in which M. Negri has been involved in order to define reference technical standards.

Technical Standards at National level.

- TS.1 A. Belussi, M. Negri, G. Pelagatti, "Il modello concettuale GeoUML: Specifica formale in UML", Standard specifications for the realization of the Italian geo-topographic database, IntesaGIS doc. n. 1n1010_1, v.2.1, 7/4/2004, approved by Comitato Tecnico Nazionale per il coordinamento informatico dei dati territoriali, published by CNIPA (Italian National Authority for Informatics in the Public Administration), now AGID (Agenzia per l'Italia digitale) www.agid.gov.it 2007.
- TS.2 A. Belussi, F. Liguori, M. Negri, G. Pelagatti, "Specifiche di contenuto: Lo schema del contenuto in GeoUML", Standard specifications for the realization of the Italian geo-topographic database, revision of the IntesaGIS doc. n.1n1007_4, 2004, v.3.3, 25/4/2006 approved by Comitato Tecnico Nazionale per il coordinamento informatico dei dati territoriali, published by CNIPA (Italian National Authority for Informatics in the Public Administration), now AGID (Agenzia per l'Italia digitale) www.agid.gov.it 2007.
- TS.3 A. Belussi, M. Negri, G. Pelagatti, "Il modello GeoUML – Regole di interpretazione delle specifiche di contenuto per i DataBase Geotopografici", Allegato 2 al DECRETO DELLA PRESIDENZA DEL CONSIGLIO DEI MINISTRI, Regole tecniche per la definizione delle specifiche di contenuto dei database geotopografici 10 novembre 2011. Gazzetta Ufficiale n. 48 del 27/02/2012 - Supplemento ordinario n. 37, also available on <http://geodati.gov.it/geoportale/datiterritoriali/regole-tecniche> file [Decreto 10/11/2011 - Specifiche di contenuto - allegato 2](#) (pdf)

Technical Standards at Regional level

- TS.4 M. Negri, G. Pelagatti, "Linee guida per la costruzione del Sistema Informativo Integrato del Sottosuolo (SIIS)", BOLLETTINO UFFICIALE DELLA REGIONE LOMBARDIA, 23 bis, pp. 1-101, 2008,
- TS.5 F. Guzzetti, F. Liguori, M. Negri, C. Dell'orto, "Specifiche tecniche aerofotogrammetriche per la realizzazione del Database topografico alle scale 1:1000 e 1:2000 - Specifiche tecniche aerofotogrammetriche per la realizzazione del Database topografico alle scale 1:5000 e 1:10000 - Specifiche di contenuto e schema fisico di consegna del database topografico - Specifiche tecniche per l'aggiornamento di cartografie numeriche ed il loro adeguamento al database topografico", BOLLETTINO UFFICIALE DELLA REGIONE LOMBARDIA, 1° supplemento, pp. 1- 200, 208.

Chapters in national books

- NB.1 Book "Per una cartografia tematica lombarda", editor F. Sartori, Series ricerche & risultati, Fondazione Lombardia per l'Ambiente, 2001:
- M. Negri, A. Toccolini, N. Fumagalli, "Significato di SIT e GIS", chapter 13.

- M.Negri, S.Avogadro, “La strutturazione della base dati ambientale e la progettazione concettuale”, chapter 15.
- M.Negri, S.Avogadro, “La progettazione logica”, chapter 16.
- M.Negri, S.Avogadro, “La base dati ambientale del progetto”, chapter 17.

NB.2 Book “Carta Naturalistica della Lombardia”, editor M.Mariotti, C.Margiocco, Series “Ricerche&risultati”, Fondazione Lombardia per l'Ambiente, 2002.

- M.Negri, “Sistemi Informativi Territoriali: caratteri generali”, chapter 1.2.
- M.Negri, G.Zuliani, “Struttura della base dati”, chapter 2.3.
- C.Margiocco, M.Mariotti, M.Negri, “Il SIT come sistema aperto: aggiornamento e completamento della struttura e diffusione dei dati”, chapters 4.1 e 4.2

Design and implementation of software tools

M.Negri contributed actively as a member of the spatialDBgroup research team of the Politecnico di Milano to the design and the realization of the following software tools in the context of the researches and projects funded by CISIS (for details please visit spatialdbgroup.polimi.it).



SW.1 GeoUMLcatalogue - last version 3.0 - 2016: case tool based on the GeoUML data model for the definition of conceptual schemas of spatial databases, their physical mapping in terms of data structures of SQL-based technologies or of the currently widespread spatial exchange technologies like Shape or GML files.

SW.2 GeoUMLvalidator - last version 3.0 - 2016: tool for the evaluation of the conformance of a dataset (spatial database, exchange file) to the conceptual specification designed using the GeoUMLcatalogue. It performs a structural validation of data (correctness of each spatial and traditional value, object identification, referential integrity constraints) and the validation of the spatial constraints defined on the spatial data.

SW.3 IDMB version 1.0beta - 2014: tool consisting of three components: the **Model Browser** to explore INSPIRE conceptual schemas, the **SQL Mapper** to create the SQL-based data structures of the INSPIRE Conceptual schemas in PostGis INSPIRE databases and the **WFS Configurator** to configure a web feature service based on Deegree technology in order to provide data stored in INSPIRE databases.

SW.4 IDMT **Semantic Mapper** (not yet available): tool supporting the semantic transformation of Italian geo-topographic databases (based on the GeoUML data model) into INSPIRE databases (based on the INSPIRE data model).

Other contributions

OT.1 Negri, et al., Informatica nei licei nel contesto della riforma della scuola, supplement of journal Mondo Digitale (AICA), n.4, anno II, pp 1-24, 2003

OT.2 M.Negri, G.Pelagatti, R.Bolis, “Principi e strategia di sviluppo del Sistema Informativo Integrato del Sottosuolo”, newsletter Sottosopra, Anno 1, n.1, pp. 11-13, DG Reti e servizi di Pubblica Utilità, Regione Lombardia, June 2006.

OT.3 A.Belussi, F. Liguori, M.Negri, G.Pelagatti, “L’interoperabilità dei dati territoriali: studi ed esperienze”, in Innovazione e Governo del Territorio: l’informazione geografica in Lombardia, pp.28-29, supplement to n. 61 of the journal MondoGIS, 2007.

- OT.4 M.Negri, G.Pelagatti, "La sperimentazione di interoperabilità tra Comune e AEM di Cremona", newsletter Sottosopra, Anno 1, n.5, pp. 7-9, DG Reti e servizi di Pubblica Utilità, Regione Lombardia, March 2007.
- OT.5 A.Belussi, J.Marca, M.Negri, G.Pelagatti, "La metodologia e gli strumenti GeoUML per definire le specifiche e validare i contenuti dei database geotopografici", GEOmedia, vol.17, n.1, pp.12-14, 2013.