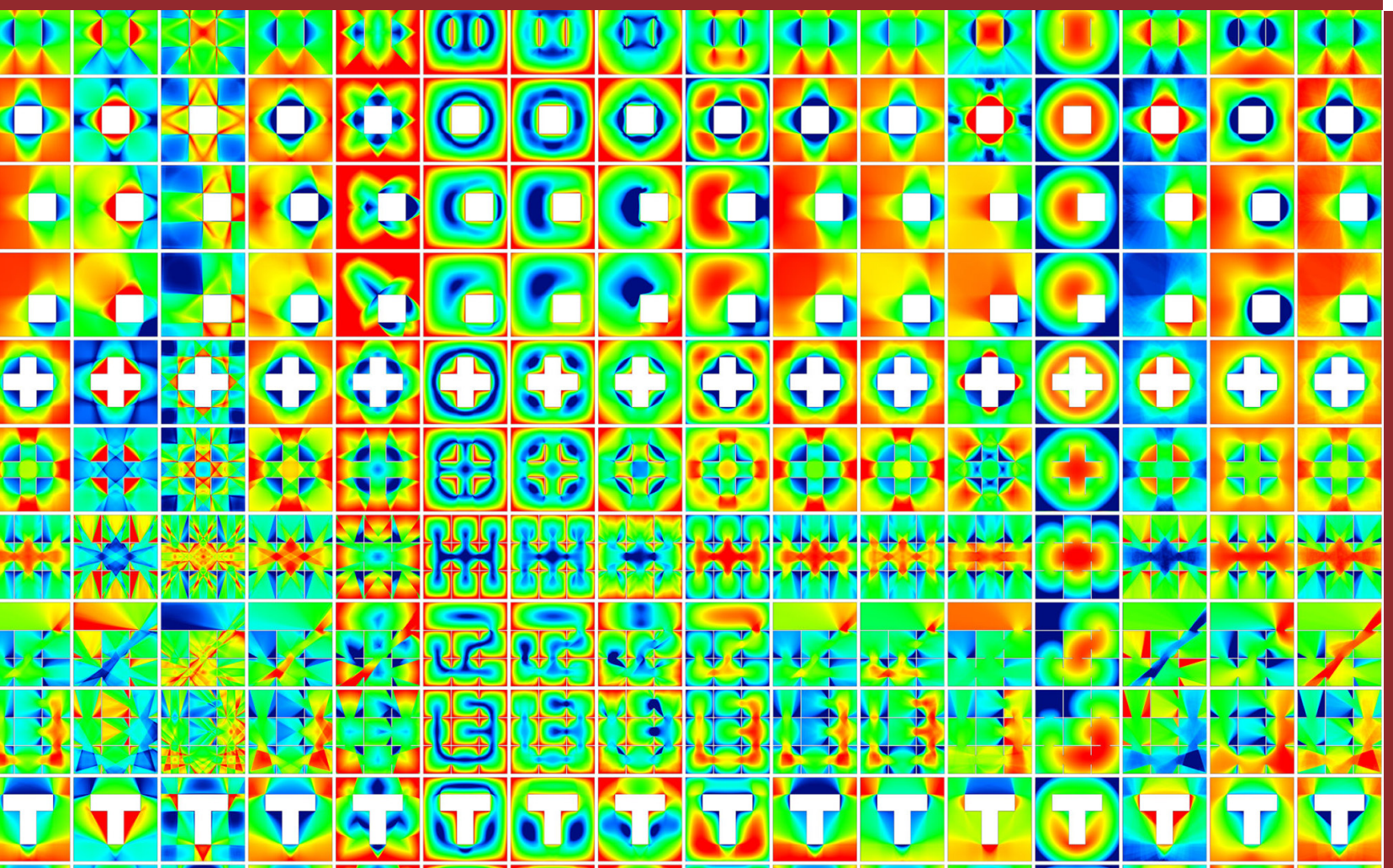
University for the Creative Arts
Research Project Portfolios

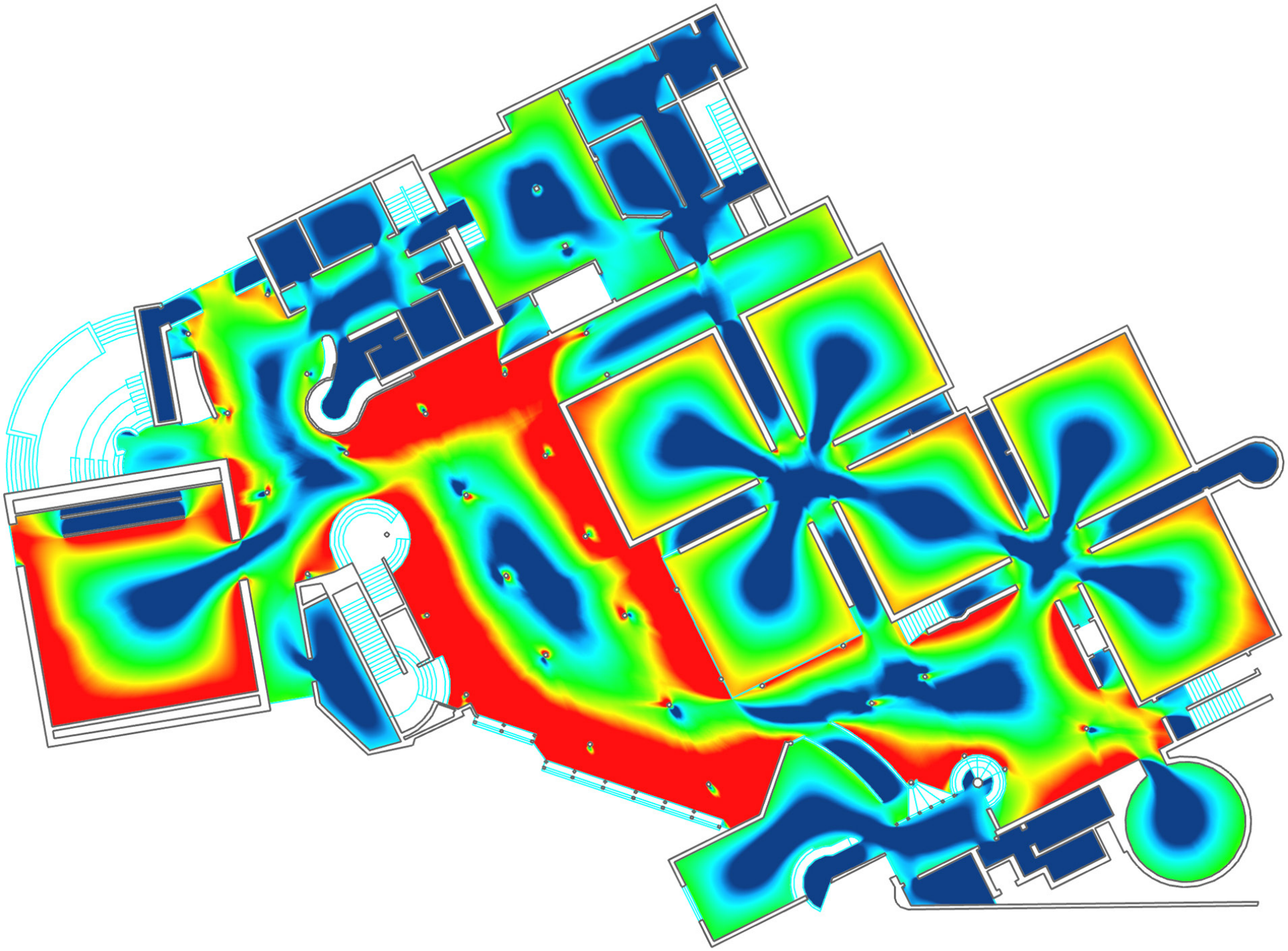
Isovist

By Sam McElhinney



Project Details

Name of Researcher:	Sam McElhinney
Name of Output:	Isovist high resolution spatial analysis application
UCARO link/s:	https://research.uca.ac.uk/4248/
Output Type:	T – Other; multi-component output comprising software and 2 journal articles containing theoretical and contextual research
Year and mode of dissemination:	Isovists.org Spatial analysis software made available to the public in 2017, announced at the 11th Annual International Space Syntax Symposium, Lisbon Published articles: Psarra, S. and McElhinney, S., 2014. 'Just around the corner from where you are: Probabilistic isovist fields, inference and embodied projection'. *The Journal of Space Syntax*, 5(1), pp.109-132. Benedikt, M. And McElhinney, S., 2019. 'Isovists and the Metrics of Architectural Space'. Conference: ACSA 2019: BLACK BOX: Articulating Architecture's Core in the Post-Digital Era, At Pittsburgh, March 27-30, 2019
Key Words:	Isovist, stochastic, overlap, inference, embodied projection, spatial analysis, space sytnax



Accessible Space; Connectivity
Mönchengladbach Museum Abteiberg; Mönchengladbach, Germany; Hans Hollein, 1982

Synopsis

Isovist_App is a free multi-platform software tool designed as an intuitive interface to advance the learning and adoption of spatial analysis techniques at all levels from undergraduate learning to advanced research and in design practice. It is based upon the spatial unit of the 'isovist', defined as the finite volume of space that is visible at any given point at which a perceiver might exist.

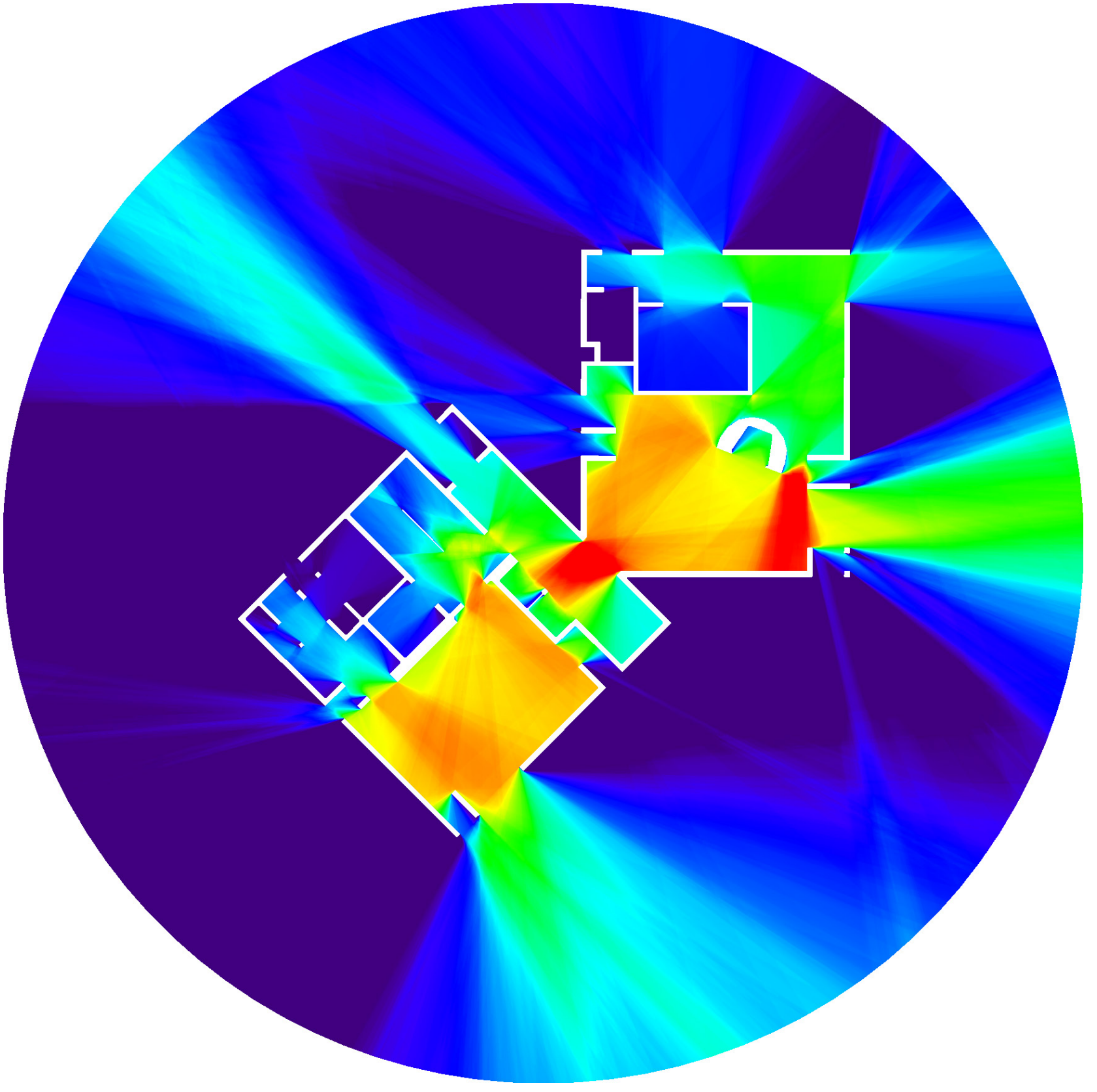
The software is available for download on isovists.org, an online platform that includes user manuals and a growing library of case studies and applications. A series of CPD workshops have led to the software being increasingly adopted in industry as a diagnostic design tool to determine evidence for and justify design proposals.

The research has made a significant contribution to the design processes of individual professionals and practices' client-facing communication. Architectural practices adopting the software include Spacelab, Waugh Thistleton Architects; CBRE LAB Real Estate, and Spacon & X. Isovist_App is also widely used within academia for teaching and research.

Since October 2018, c.16,000 individual uses of the software have been recorded across 54 countries. A total of 1,065 validated users have registered on the isovists.org website; approximately 50% have self-identified as student users, 23% as educators or researchers, and the remainder as design practitioners. Significant use beyond the UK (3,252 single uses) appears to be centred in China (2,090), the USA (1,420), Switzerland (1,390), India (1,110), Germany (640), Iran (624), the Netherlands (593), Japan (574), and Mexico (500).

This supporting portfolio includes evidence of the research aims, context and processes which led to new insights. It includes print-screens of Isovist analysis interface, a PDF of the two journal papers containing theoretical and contextual research, and the user guide. Isovist_App is free to download, and to view the community blog and case studies see www.isovists.org.

Visibility fields in Kahn's Fisher House



Context

The measures and fields generated by the Isovist_App have been developed from the isovist literature originated by Professor Michael Benedikt, as well as from Space Syntax literature based on the work of Professor Bill Hillier and Professor Julienne Hanson. The two literatures overlap, conceptually and in application. Isovist work tends to focus on building interiors, and on human social and aesthetic experience and perception, whilst Space Syntax tends to focus on the city, behaviour and configurative aspects of space. The Isovist_App bridges between all scales, from single rooms to urban street patterns, and so aims to be useful to both areas of interest.

Collectively, the tools of the Isovist_App allow the user to examine and isolate spatial transformations or configurative properties, to gain understanding of the spaces of the built environment, and infer knowledge on how people respond and behave within them. It can show isovists directly, compute inherent geometrical or relational properties of them as 'measures' and display spatial representations of how such measures are distributed in space as 'fields'. The tool-set provides real-time, high definition spatial analysis data from easily prepared plans and sections, via an original and novel continuous-time stochastic sampling methodology. As such the Isovist_App provides new functional utility, methods and tools as an alternative to traditional but computationally lengthy and finite 'visibility graph analysis' research methods. It does so at resolutions that negate concerns of spatial grid definition associated with such methods.

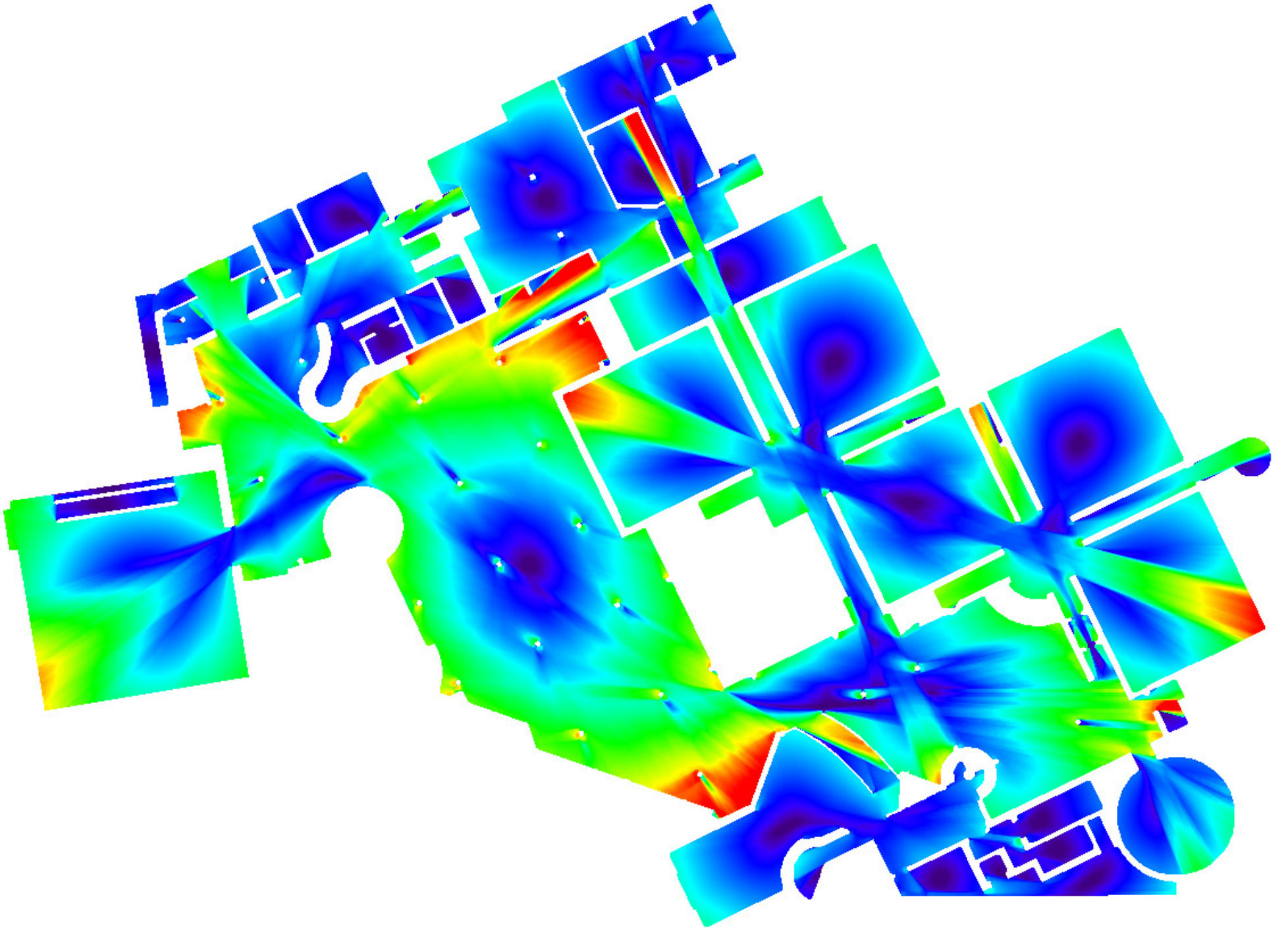
The development of the Isovist_App has benefitted from McElhinney's collaborations with pioneering leaders in the field, including Dr Sophia Psarra at University College London, and Professor Michael Benedikt at the University of Texas at Austin. A key research paper titled 'Just around the corner from where you are' (Psarra & McElhinney, 2014) outlines the underlying stochastic sampling premise as a path to advanced spatial analysis, synthesizing the theory and computational approaches into a working method. A development of the approach, the theory and further methodological applications are illustrated in a research paper titled 'Isovists and the Metrics of Architectural Space' (McElhinney and Benedikt, 2019).

The Isovist program was developed and written by McElhinney with the participation of Benedikt, using the theory to impact architectural practice through the development of computer software.

REFERENCES

Benedikt, M.L., 1979. 'To take hold of space: isovists and isovist fields'. *Environment and Planning B: Planning and Design*, 6(1), pp.47-65

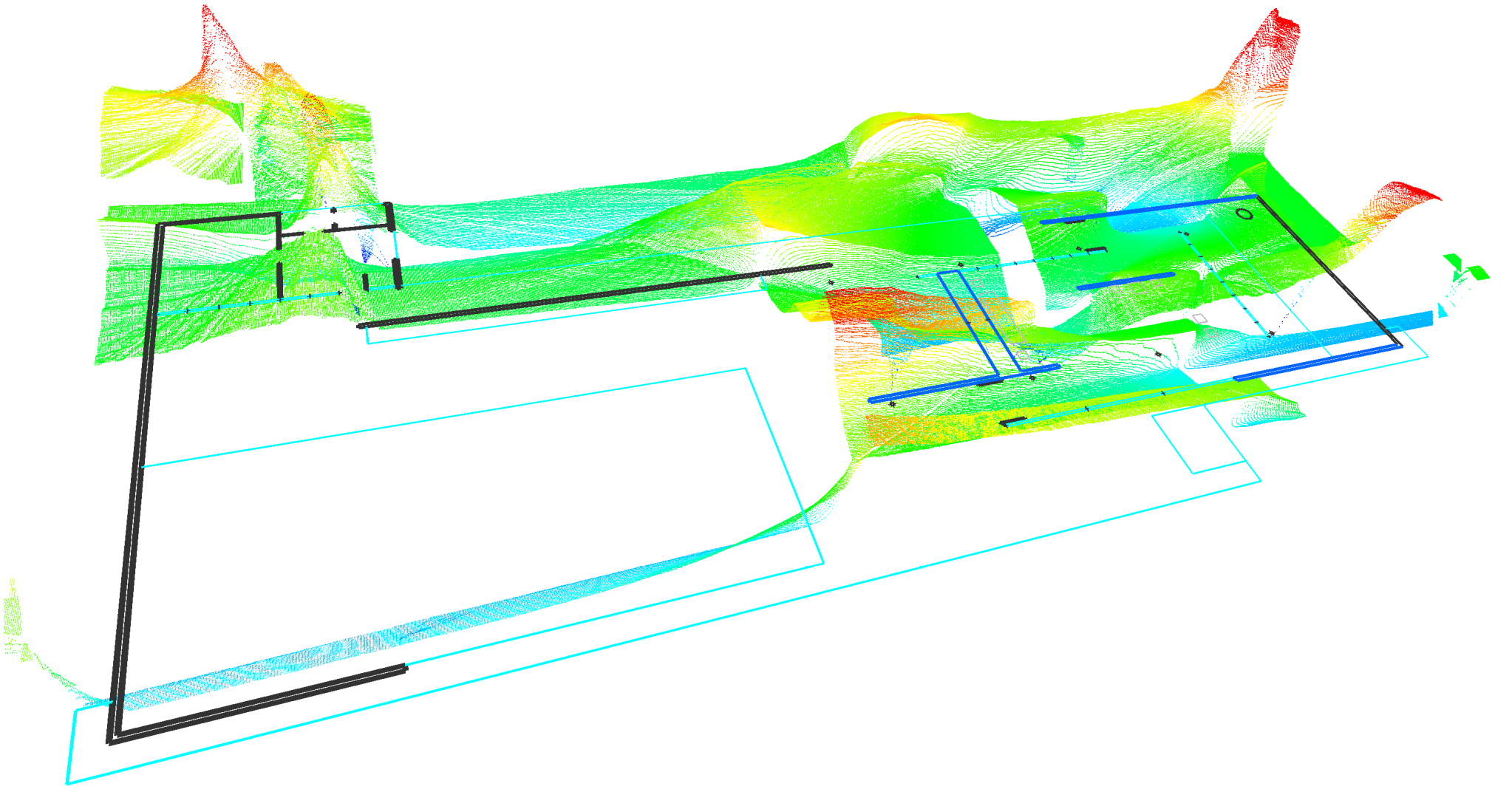
Hillier, B., Leaman, A., Stansall, P. and Bedford, M., 1976. 'Space syntax'. *Environment and Planning B: Planning and Design*, 3(2), pp.147-185.



Drift field in Hollein's Muncheng-ladbach Museum

Research Questions and Aims

Research questions:	• How can we reconceptualise the relationship between the observer, embodied vision and the overall spatial environment? • How can we develop contemporary methods of spatial analysis that are highly responsive to the user and not limited by finite analysis methods, nor require an arbitrary discretisation of space? • What metrics can be extracted from architectural plans and sections and how are these of use to the modern researcher and designer?
Research aims:	• To provide advanced high definition, intuitive toolsets for the analysis of architectural space. • To help students, architects, designers and researchers to better understand the built environment and how people might respond to it. • To better illuminate how past architects have used subtle variations to create, contain, and divide unique spaces. • To improve understanding of how building configuration and spatial geometry influence human cognitive understanding, social experience, and occupant behaviour. • To encourage an increase in evidence based design practices and building ‘performance’ perceptions in academia and in industry.



3d view of a Control field in Mies Van Der Rohe's Barcelona Pavilion

Research Methods and Process

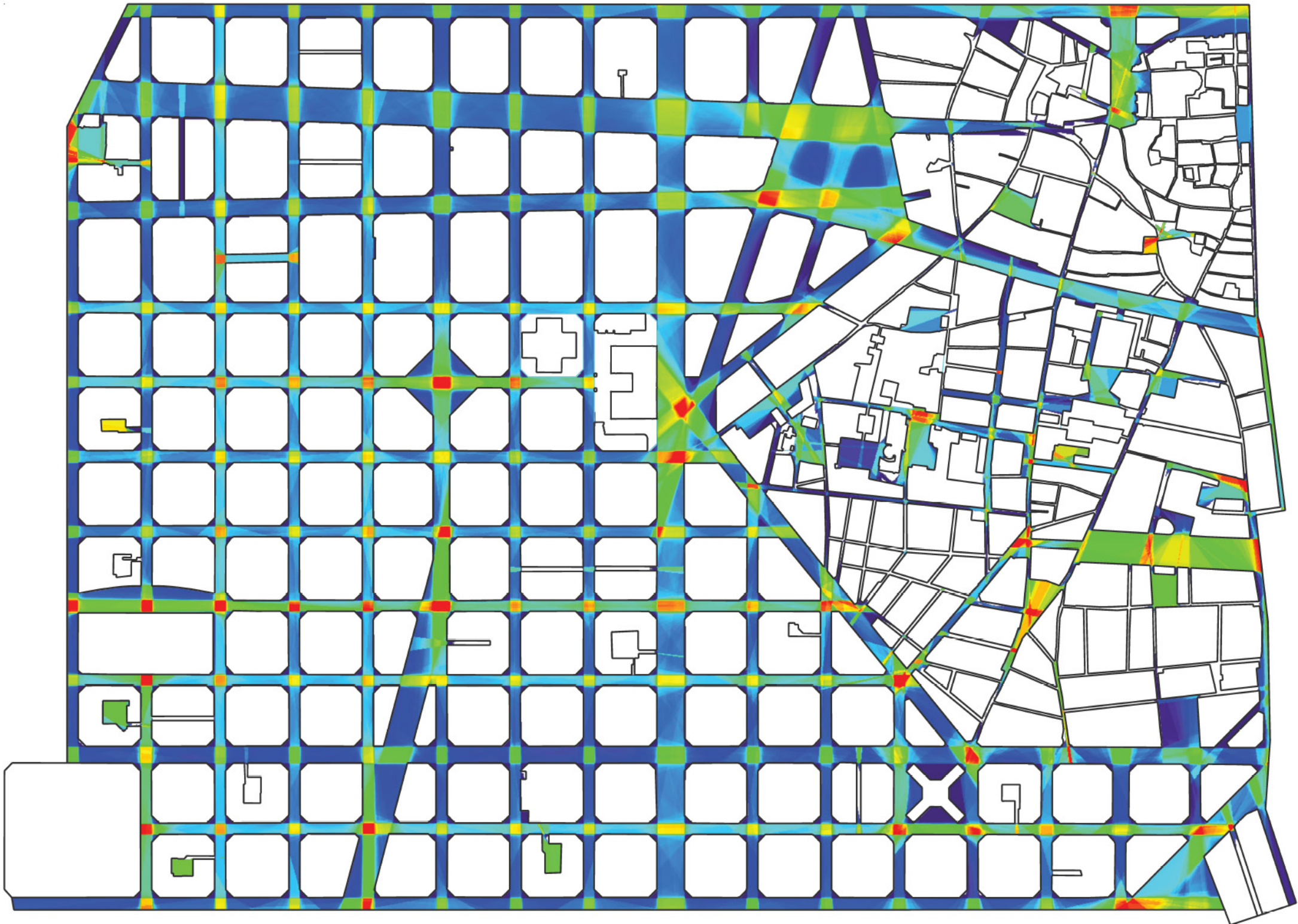
Compared to other visibility graph analysis software, notably DepthMapX, Isovist 2.3 data is achieved at circa 25 times the resolution in 1/60th the calculation time.

Of the twenty-one different fields produced by the Isovist_App, ten are ‘local’ isovist measures that relate to occupant experience within space; Area (or Connectivity), Perimeter, Compactness, Occlusivity, Vista Length, Average Radial, Drift, Variance, Skewness and Curvature. Five are ‘global’ Space Syntax-type measures that characterise configurational relations across a plan as a whole; Choice, Mean Metric Depth, Mean Visual Depth, Mean Angular Depth, and Integration (HH). The remaining six measures are ‘semi-local’ or relational measures that span between local and global information; Visibility, Control, Controllability, Metric Depth to Location, Visual Depth to Location and Angular Depth to Location.

In addition to rapid field analysis, the Isovist_App can conduct real-time point isovist, path isovist, region isovist and isovist agent analyses. The software incorporates parametric innovations for these analysis that were never previously available on a single platform. The user can specify a given angle for the study of viewsheds as well as a direction of viewing. In addition, the user can specify a metric threshold for limiting the visual field. These innovations are relevant in studies where the clarity of viewing specific targets matters (as when nurses look at their patients from short distances, in Intensive care units, or as when visitors look at exhibits in a museum).

Results from the Isovist_App can be output as high-resolution coloured pdfs, or as numeric point data. The software also includes an integrated scatter graph tool that can be used to review correlations (or lack thereof) between the massive data sets produced for each measure field. Such information allows intuitive and empirical exploration of experiential, navigational or socially significant affordances within existing or proposed spatial structures.

Control field in Barcelona fragment urban plan



Research Contribution and Recognition

Research insights and contribution:	The scientific significance of McElhinney's work lies in the fundamental conceptual advances that provide a novel mathematical and algorithmic basis for Isovist and syntactic analyses. These have been embedded into a new software toolset that provides analysis at orders of magnitude faster and at much higher resolution than previous methods. These advances provides a richer and more rigorous future modelling of aspects of built space, its configuration and form, and likely human experience and cognition within it. Isovist analytical capabilities aids practices in taking robust and evidence-informed design decisions, and so directly contributes to improvements of the built environment.
Dissemination:	The software, its development and its use are hosted on isovists.org which provides a platform for further dissemination. In addition, key moments of dissemination include: • Presentation at the 11th Annual International Space Syntax Symposium in Lisbon 2017 • ACSA 2019: BLACK BOX: Articulating Architecture's Core in the Post-Digital Era, At Pittsburgh, March 27-30, 2019 • A keynote invited workshop at the 12th Annual International Space Syntax Symposium in Beijing 2019 • Numerous built environment industry facing invited CPD workshops and presentations on approaches to evidence based design, at practices including: Hawkins Brown (London, 2017), Fosters and Partners (London, 2018), SpaceLab (London, 2019), Erik Arkitekter (Copenhagen, 2019), Perkins and Will (London, 2019), Woods Bagot (London 2020), Maynard Design (London, 2020), One.Go Real Estate (Netherlands, 2020), Sybarite (London, 2020)

Research Contribution and Recognition

Influence of the research:

An ongoing dialogue is emerging between a community of researchers, educators, students and architectural practices associated with the Isovist App. The latter includes significant teaching activities and research activities in which the software provides a core component; all with the expressed aim of improving the quality of the built environment through evidenced based design and spatial analytics.

The software was an instrumental part of the winning proposal for the British Council Rogelio Salona Fellowship 2019, awarded to Greg Maya, for an extended residency in Columbia.
https://design.britishcouncil.org/blog/2019/jun/06/rogelio-salmona-fellow-2019-gregorio-maya/ and documented also on Isovists.org

Further known academic workshops (taught content) and extended teaching programmes of analysis/design in which the Isovist App has been a key element include:

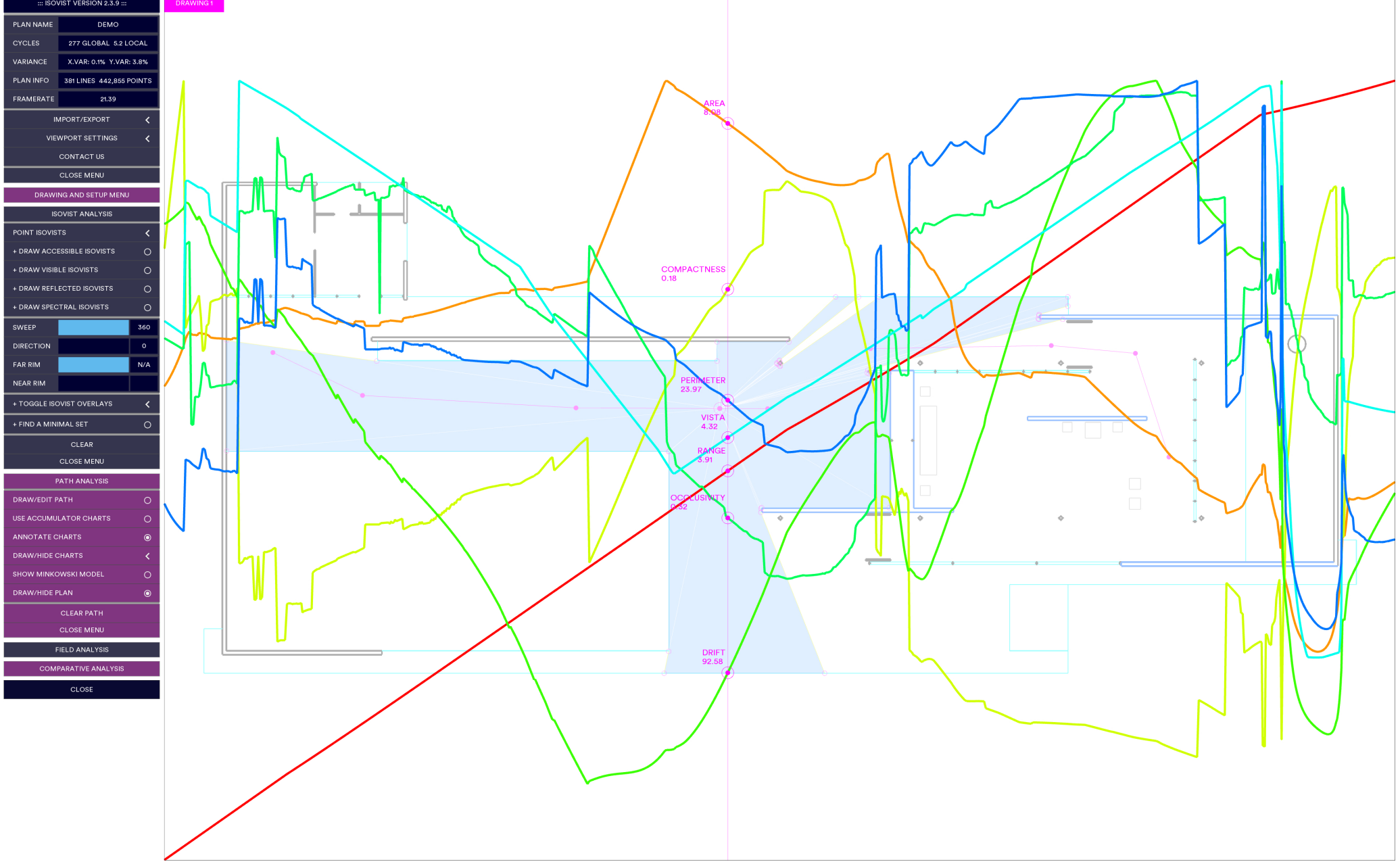
- CEPT University, School of Architecture, (India)
- UCL Bartlett School of Architecture, (UK)
- Georgia Institute of Technology, (USA)
- University of Texas at Austin, (USA)
- University of Basel, Classics Department, (Switzerland)
- ETH Zurich, Cognitive Science/Architecture Department, (Switzerland)
- Smith College Dance Department, (USA)
- Universidad del Bío-Bío, Department of Architecure and Design Theory, (Chile)
- Universitat Politècnica de Catalunya, School of Architecture, Barcelona, (Spain)
- Muenster Institute for Geoinformatics, Spatial Intelligence Lab, (Germany)

Research Contribution and Recognition

Influence of the research:

The software is also known to have been adopted as a key aspect of both ongoing individual PhD efforts and larger research programmes at the following institutions (only those with whom confirmatory correspondence have been established are listed):

- North Carolina State, College of Design, (USA)
- University of Florida, College of Design and Planning, (USA)
- Michigan State University, (USA)
- University of Life Sciences, Lublin, (Poland)
- Ghent University, CartoGIS Group, (Belgium)
- Bar Illan University, Department of Geography, (Israel)
- University of Tehran, School of Architecture, (Iran)
- Universidad Nacional de Mar del Plata, (Argentina)
- Zurich University of the Applied Sciences, (Switzerland)
- Shenzhen University, Department of Architecture, (China)
- Minia University, Faculty of Engineering, (Egypt)
- Universidad del Bío-Bío, Department of Architecture & Design Theory (Chile)



Path Analysis within the Isovist_ App

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Graphic Design: Studio Mothership