

85th European Study Group with Industry



University of East Anglia, Norwich

16th–20th April 2012

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1 Introduction

Welcome to the University of East Anglia and the 85th European Study Group with Industry. We hope you will have a rewarding and enjoyable time working together at UEA. We are pleased to bring this prestigious event to Norwich.

We welcome the problems to be presented by visitors from the companies and other organisations, and we are also pleased to see such a distinguished group of mathematicians from UK and overseas who will contribute their penetrating and imaginative ideas to the solutions on Friday. There are nearly 100 visiting delegates and local mathematicians. About half are postdoctoral researchers and PhD students.

Please come to the drinks reception on Monday at 18:00. We welcome your contributions to the meeting, through bold talking, constructive listening and positive debating, in the problem rooms and elsewhere. On Wednesday evening you will have time to see central Norwich, an unspoiled medieval city. The ESGI dinner will take place on Wednesday evening in the Refectory in the complex of buildings next to the (Anglican!) Cathedral in central Norwich. If you get lost, the white spire of the Cathedral is the second tallest in England.

The meeting will end with the Problem Reports on Friday morning, and the award of the 'Colemanballs' Prize for the best or worst unguarded spoken comment of the week.

The Organising Committee warmly acknowledges support for ESGI 85 from the Engineering and Physical Sciences Research Council, the Knowledge Transfer Network for Industrial Mathematics, the University of East Anglia, and the School of Mathematics at UEA. We would also like to thank the staff in the conference office, SCI local support office, and IT support for their help with the organisation of the meeting.

To show others that you are with ESGI 85, please wear your name badge. The organisers are here to help you get the most out of your working visit this week, so please ask any of the local helpers if you have any questions.

With best wishes for your stay at UEA,

Richard Purvis and the local organising committee

(Robert Whittaker, Emilian Parau, Paul Hammerton, and Mark Cooker)

2 Meeting Programme

The timetable for the week is shown in the table below. The meeting starts at 9:30am on Monday 16th April, and will finish after lunch on Friday 20th April.

	Monday	Tuesday	Wednesday	Thursday	Friday		
09:00	Registration (TPSC Foyer)	Group Work	Group Work	Group Work	Presentations (TPSC LT)		
09:45	Introduction						
10:00	Problem Descriptions (TPSC LT)						
11:00	Tea and Coffee Break (TPSC Foyer)						
11:30	Problem Descriptions (TPSC LT)	Group Work	Group Work	Group Work	Presentations (TPSC LT)		
13:00	Lunch (TPSC Foyer)						
14:00	Problem Descriptions (TPSC LT) Group Work	Group Work	Group Work	Group Work			
15:30	Tea and Coffee Break (TPSC Foyer)						
16:00	Group Work					Group Work	Group Work
16:30						Progress Reports (TPSC LT)	
18:00							
	Wine Reception (TPSC Foyer)						
19:30	Dinner (Vista)	Dinner (Vista)	Banquet (Norwich Cathedral)	Dinner (Vista)			
20:30	Bar (Union Bar)			Bar (Union Bar)			

Most of the activities take place in the Thomas Paine Study Centre (TPSC). The Foyer and Lecture theatre (TPSC LT) are located on the ground floor. The Group work takes place in a number of different rooms in the same building: TPSC 0.1 on the ground floor, and TPSC 1.1–1.5 on the first floor. (See the plans on page 9.)

3 Travel to UEA

The University of East Anglia is located on the edge of the city of Norwich. Norwich is easily accessible by road, rail, bus and coach. Norwich International Airport also offers direct flights to and from Aberdeen, Amsterdam, Edinburgh, Manchester and Paris.

For full details see <http://www.uea.ac.uk/about/gettinghere>

Attendance at the meeting, accommodation, and meals are all provided free of charge, but participants must cover their own travelling expenses.

3.1 Travelling by Car

For sat-navs and online maps, the University's postcode is "NR4 7TJ". Free parking on campus is available for ESGI participants. Please park in the main Visitors' Car Park (see campus map on page 9). You will be given a token by the machine at the entrance barriers. This then needs to be validated either at the accommodation reception at Broadview Lodge, or during one of the breaks in the Thomas Paine Foyer.

3.2 Travelling by Train

After arriving at Norwich Railway Station, a taxi to the University campus will take 15-20 minutes and cost around £10. Alternatively, you can catch a number 25 or 35 bus from the Station forecourt, which both stop inside the University Campus (stops are shown on the campus map on page 9). The buses run every 5-10 minutes, and the journey will take around 40 minutes.

If you are travelling by train from London, then please note that there are engineering works on the line between London Liverpool Street and Norwich on Sunday 15th. You will likely be directed via Cambridge / Ely instead, and it will probably be quicker to leave London from Kings Cross rather than Liverpool Street.

4 Accommodation

Participants who have requested accommodation will be staying in Broadview Lodge on the UEA campus. Check-in is from 2pm on the day of arrival, though you should be able to leave any bags there if you arrive before this. The Reception at Broadview Lodge closes at 9pm. Anyone arriving later than this can collect their keys from the UEA Security Lodge. It would be helpful if anyone expecting to arrive later could let us know in advance.

For more information about the accommodation, please see <http://www.broadviewlodge.co.uk/>.

5 Security, Health & Emergencies

The University of East Anglia is an open campus and the exterior doors to most buildings are unlocked during the day. Therefore please be careful with your personal belongings and do not leave any laptops or other valuable items unattended.

If you have a security or other emergency then contact the Security Lodge (located next to the roundabout where University Drive and Chancellors Drive meet) which is manned 24 hours a day. Telephone 01603 592352 for general enquiries or 01603 592222 in an emergency.

The UEA Medical Centre on campus is located on University Drive, next to the Bluebell Road entrance to the campus, and is open during the day. For general enquires phone 01603 251600. Out of hours, recorded information will tell you how to contact the duty medical doctor. For medical emergencies, please phone the security lodge on 01603 592222 who will arrange for an ambulance or other help as appropriate.

If the fire alarms go off please follow the green signs to exit the building and assemble outside in the safe area.

6 Meals and Refreshments

6.1 Breakfast

For those staying in Broadview lodge, breakfast will be served in Zest (ground floor of the Restaurant block on Union Square) from 7:30am each morning. You should be given a voucher for breakfast when you check in to your accommodation.

6.2 Tea and Coffee Breaks

Tea, coffee, soft drinks and biscuits will be served at 11am and 3:30pm each day in the Foyer (ground floor) of the Thomas Paine Study Centre.

6.3 Lunch

A buffet lunch will be provided for all attendees. This will be served between 1pm and 2pm in the Foyer (ground floor) of the Thomas Paine Study Centre.

6.4 Dinner (Monday, Tuesday, Thursday)

For residential participants, dinner will be served in Vista (top floor of the restaurant block on Union Square) at 7:30pm on Monday, Tuesday and Thursday evenings.

After the meals, participants might like to make their way across the square to the Union Bar for further refreshments.

6.5 Conference Banquet (Wednesday)

The conference banquet (for residential and non-residential participants) will take place on Wednesday evening in the Refectory at Norwich Cathedral, at 7:30pm for 8pm. There is no dress code; wear whatever you feel comfortable in.

Participants should make their own way to and from the venue, though local participants will be available to act as guides. Unless you wish to take a taxi, we would recommend using the 25 and 35 public service buses. These leave every 10-15 minutes from the Chancellor's Drive bus stops on Campus. Participants should disembark at the stop on Prince of Wales Road, and from there it is a six-minute walk. We suggest catching one of the buses before about 6:45pm in order to arrive in plenty of time.

If you wish for further refreshments before or after the meal, we recommend the following good-quality pubs, which serve good beer and are quiet enough to be welcoming for conversationalists:

- **Wig and Pen** (200m along Palace Street to where Whitefriars meets Bishopgate). This pub is 17th century and serves a good range of local ales (and good food too). Postcode: NR3 1RN.
- **Adam and Eve** (Bishopgate, behind the Anglican Cathedral). Reputed to be the oldest pub in Norwich. Postcode: NR3 1RZ.
- **Ribs of Beef** (walk north from the Cathedral, and it is by the bridge on Wensum Street). This pub has a good atmosphere with real ales, as well as river views. Postcode: NR3 1HY.
- **Kings Head** (A couple of minutes walk north along Magdalen Street over the river beyond the Ribs of Beef). A former Norwich CAMRA Pub of the Year with many local real ales on tap, as well as Belgian beers (and a Bar Billiards table). Postcode: NR3 1JE.

7 Computing Facilities & Internet Access

Wireless internet access will be available throughout the meeting, and should be accessible in all the problem rooms and in the restaurant/bar areas on campus. In the accommodation in Broadview Lodge, wireless access is available via BT OpenZone, for which vouchers can be purchased from reception for an additional charge. Wireless access via Eduroam may work too. Wired access is available via Eduroam or a UEA visitor account, but participants may need to bring their own ethernet cable in order to use this.

7.1 Eduroam Access

Participants whose home institution supports Eduroam will be able to use the Eduroam wireless network at UEA. Participants should set up their laptop or other device to connect to Eduroam at their home institution, following the instructions provided by their own Computing Service.

Details of the Eduroam service at UEA can be found at <http://www.uea.ac.uk/is/wireless/eduroam> along with connection instructions for UEA members, which may be helpful to participants.

7.2 Non-Eduroam Guest Accounts

We will also be able to provide individual guest accounts for participants whose home institutions do not support Eduroam. We would be grateful if those people could let us know in advance, so we can ensure that enough accounts are available. If you need a guest account details will be available at the registration desk in the TPSC Foyer on Monday morning.

7.3 Computer Terminals

Participants with individual guest accounts should also be able to log into the computer in each of the problem rooms. We may be able to provide access to a computer room too if more people need access. But you will need a local participant to show you where the room is and let you in.

7.4 Printing

Those connected to Eduroam should be able to print directly to the printer in TPSC 1.4. This printer is an “HP Color Laserjet 4700” (if you are asked to select a printer drive for it) though it may just work as a generic postscript printer.

- Windows users should “Add a Network Printer”, click “stop” to cancel the search and then use the “Add printer not listed” button. The printer location is <http://printer1.mth.uea.ac.uk:631>.
- On Ubuntu (and probably other flavours of Linux), go to “System → Admin → Printing → Add” and add a “Network Printer” using the “Internet Printing Protocol”. The host is printer1.mth.uea.ac.uk and the queue is `/printers/raw`.
- On a Mac, open “Print and Fax” from the “System Preferences” menu and click to add a printer. The host is printer1.mth.uea.ac.uk and the queue is `printers/raw`.

If direct printing does not work for you, or you are not using Eduroam, then please email the document you want to print to esgi85.print@gmail.com and ask one of the local participants to print it for you.

8 Local Information

8.1 About UEA and the School of Mathematics

Before UEA was founded, the site was a golf course. The first structures, designed by Sir Denys Lasdun, were the Arts Building, the Ziggurat (the accommodation visible from the Walkway) and the Library, all of which were recently Listed. UEA was established by funds from the whole region and its population (hence its name). The university received its royal charter, at its foundation in 1963. Michael Sanderson recently wrote *The History of the University of East Anglia, Norwich*, (Published by Hambledon, London), in time for UEA's 40th birthday. The university is still growing: there are new residences, the Sportspark and a new School of Medicine to accompany the nearby Norfolk and Norwich Hospital, opened in 2000.

Mathematics was among the founding schools at UEA. The School's research in applied mathematics includes water waves, aerodynamics, mathematical biology, viscous flows, solid mechanics and waves in continua. We have full programmes of PhD, MSc, MMath and BSc degrees. An MSc in Environmental Engineering started this year.

Some of the other schools here are Environmental Sciences, History and Biology. The School of English & American Studies is known for its Creative Writing MA (founded by the late Professor Malcolm Bradbury). Novelists who graduated from UEA include Kazuo Ishiguro and Ian McEwan. The Norwich Research Park is also home to three national research facilities: the Climatic Research Unit, the John Innes Centre (plant science research) and the Institute of Food Research.

8.2 Campus Facilities

Campus Shops

The Street (running south from Union Square) is home to a variety of shops, including a Post Office, a newsagent, a travel agent, a Waterstones book shop, a food store, a laundrette and two banks (with 24-hour cash machines). There is a Boots chemist / pharmacy in the UEA Medical Centre (located by the Bluebell Road entrance to the campus).

The Union Bar

The Union Bar is located just off Union Square. The bar will be open each evening until 11:00pm (last orders 10:50pm).

UEA Sportspark

The sports facility boasts a state-of-the-art Olympic-sized swimming pool, athletics track and gym, as well as an extensive range of activities including aerobics, archery, athletics, badminton, basketball, climbing, cricket, fencing, hockey, indoor football, martial arts, squash, table tennis, trampolining and yoga. Although Sportspark is owned and managed by the University of East Anglia it is open to everyone. Membership is not required and you can just 'Pay and Play'.

For further information, see <http://sportspark.co.uk/>.

Sainsbury Centre for Visual Arts (SCVA)

A public art gallery and museum located on the UEA Campus, in a building designed by Sir Norman Foster. It is open 10am to 5pm, Tuesday to Sunday, and admission is free.

The SCVA houses a number of collections, including: The Robert and Lisa Sainsbury Collection (featuring work spanning 5,000 years of human creativity), The UEA Collection of Abstract and Constructivist Art, Architecture and Design, and The Anderson Collection of Art Nouveau from the final years of the 19th century.

For further information, see <http://www.scva.org.uk/>.

The Broad and Wildlife Trails

The Broad is an 18-acre man-made freshwater lake in the grounds of the University. There are many footpaths around the Broad and its tributaries. A number of nature trails, and wildlife information boards have recently been installed.

For further details see <http://www.uea.ac.uk/volunteers/Wildlife+Trail+Leaflet>.

8.3 The City of Norwich

When the Romans came to occupy East Anglia, the region was already settled by the Iceni and Belgae tribes, who had made it prosperous long before. Very little is known of the Roman occupation within the current city boundaries, but they did make a stronghold two miles south, at Caistor St Edmund. The site's detailed plan was detected by aerial photography in the 1920s. Excavations revealed the current impressive remains of a walled town, where today sheep quietly graze. The local Queen Boudicca and her daughters fought the Romans, possibly from chariots, here and to the south in 61 AD, in a nearly successful revolt which sucked in almost all the occupying legions. Colchester was razed, London burned, and the fighting only ended with a violent but decisive Roman victory near St Albans.

The region supplied goods to the legions. From 120 AD, ships carried food from here, and from the Roman naval base near Colchester, to Arbeia Fort, at the mouth of the Tyne, to supply the garrisons on Hadrian's Wall. After the Roman legions left Britain in 408 AD, Norfolk continued its rural prosperity. But the deep river inlets made this an easy target for Saxon raiders, then it became part of the Danelaw, then there were more Viking raids culminating in 1010, when Cambridge and Thetford to the west were burned.

From 1066, the Norman Conquest established Norwich as a regional centre of power. With French stone (shipped from Caen to Pull's Ferry) they built the Cathedral and Castle. Both are worth seeing for their fine original architecture. William the Conqueror also built five priories here. At the time of the Domesday survey, Norfolk was the most populous English county and its eastern rural parishes were the most densely populated in England. The markets and the shipping route made medieval Norwich the third largest city in the kingdom, after London and York. The trades in mutton, fine wool and clothing, footwear and dyestuffs (including red madder) made the city rich enough to build a church for every Sunday in the year and a pub for every day of the year. For centuries the city has been home to Dutch, Jewish, Huguenot and now other communities. The prosperity aided the founding of one of England's first hospitals, in the 13th century; you can see the extant buildings near the Cathedral. Julian of Norwich (c1343–1443) named herself after the church where she lived, in seclusion. She is famous for her mystical writings (still in print): "...and all shall be well, and all manner of things shall be well."

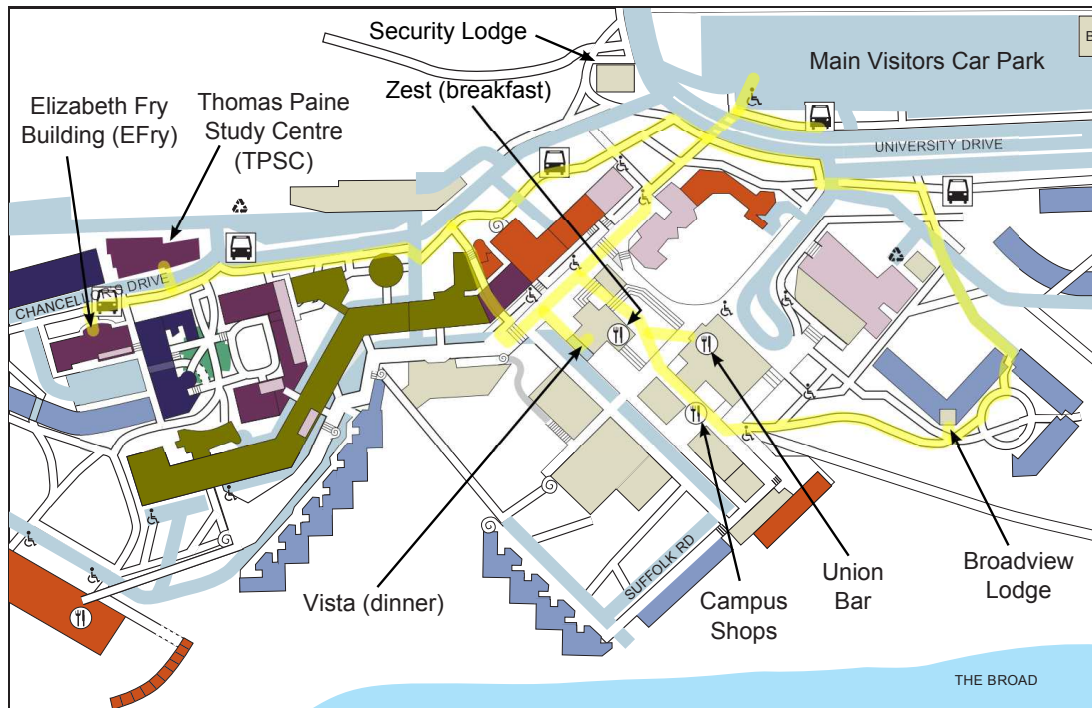
Robert Kett's Rebellion was fought against two of Edward VII's armies, in and around Norwich, in Jul–Aug 1549.

Despite its wealth, the city was never industrialised. Some sensitive local governance spared Norwich the extremes of UK post-war rebuilding and spurred the creation of UEA in 1963. This has left a thriving unspoilt city to live in, whose historic sites remain for us all to enjoy.

For further information about Norwich today, please see the leaflet and map enclosed in your conference pack, or visit the official website at <http://www.visitnorwich.co.uk/>.

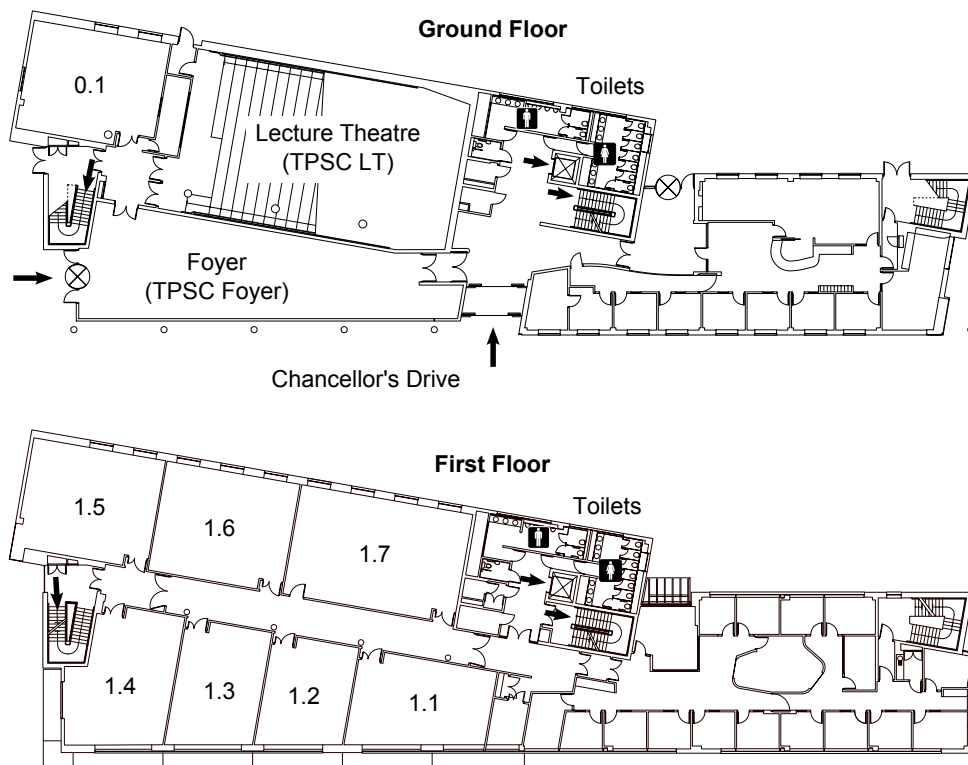
9 Maps

9.1 UEA Campus



The main sites for the study group labelled. The yellow highlight shows suggested walking routes between them. A larger map of the whole campus is also included in your welcome pack.

9.2 Thomas Paine Study Centre



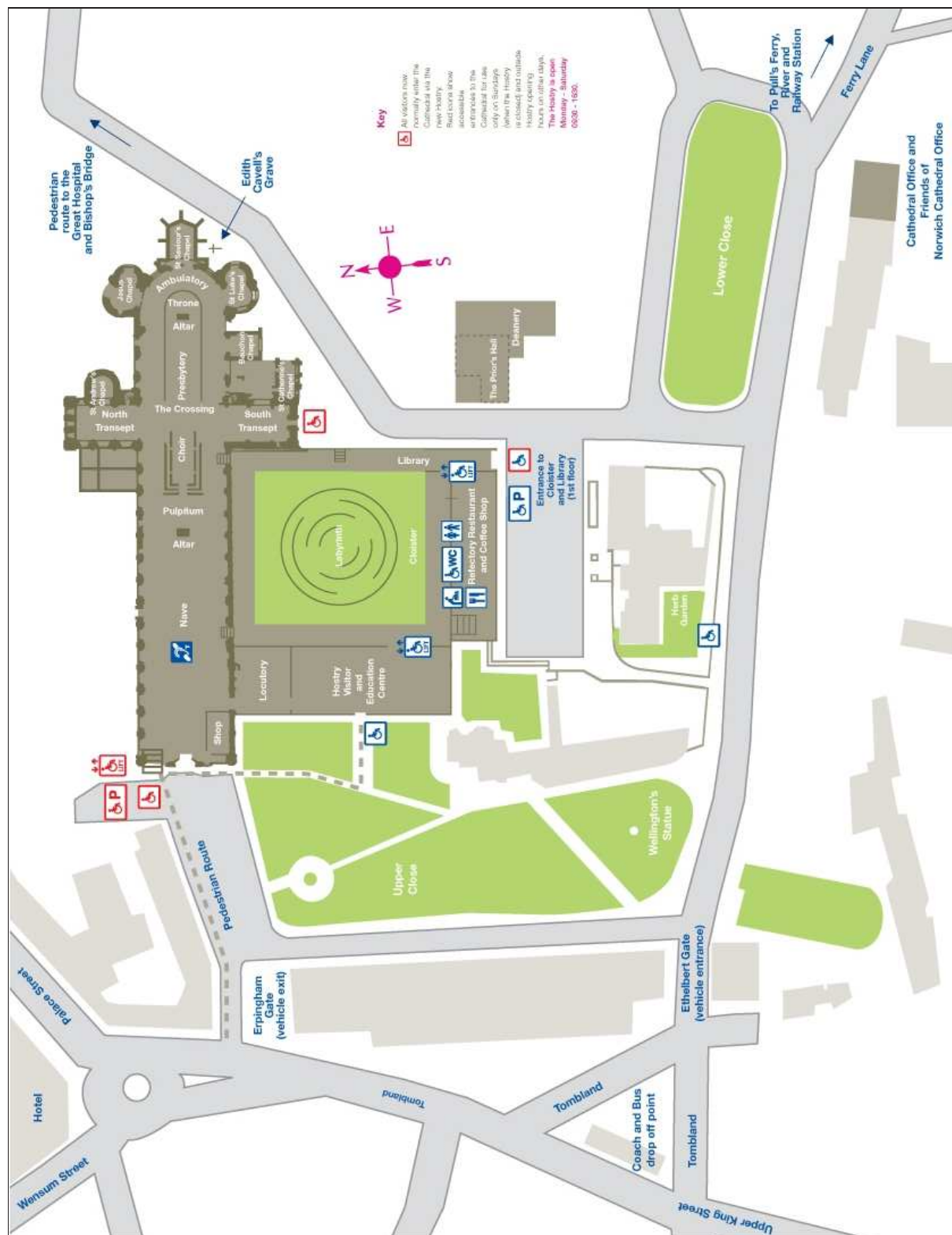
9.3 Norwich City Centre



Map image and data © OpenStreetMap Contributors, CC-BY-SA. See <http://www.osm.org/>.

The location of, and route to, the banquet are shown in yellow. The suggested pubs for before and after the meal are marked in blue. The bus stops for the number 25 and 35 buses to/from the UEA campus are shown in green (outward journey) and red (return journey).

9.4 Norwich Cathedral



10 List of Participants

Name	Affiliation	Email
Mr Mishari Al-Foraih	University of Manchester	
Dr David Allwright	Industrial Mathematics KTN	
Mr Abdulah Alzahrani	Heriot-Watt University	
Dr David Barton	University of Bristol	
David Belfourd	Airbus	
Mr Lorenz Berger	University of Oxford	
Mr Jonathan Black	University of Oxford	
Mr Chris Bocking	University of East Anglia	
Mr Ashley Brereton	Liverpool	
Mr Charles Brett	University of Warwick	
Dr Melvin Brown	Smith Institute	
Dr Richard Burguete	Airbus	
Nick Bushell	VR Technology Ltd	
Dr Chris Cawthorn	Industrial Mathematics KTN	
Mr Amine Chakhchoukh	University of Bath	
Mr Lloyd Chapman	University of Oxford	
Mr Yujia Chen	University of Oxford	
Mr Ming Cheng	The University of Manchester	
Dr Colm Connaughton	University of Warwick	
Dr Mark Cooker	University of East Anglia	
Prof Erhan Coskun	Karadeniz Technical University	
Dr Stephen Cowley	University of Cambridge	
Mr Andrew Crosby	University of Cambridge	
Dr John Curtis	AWE	
Prof Russell Davies	Cardiff University	
Mr Neil Deacon	University of East Anglia	
Dr Jeff Dewynne	Oxford University	
Dr Rod Drake	AWE	
David Evans	Poikos	
Miss Andrea Fernandez	University of Bath	
Mr Charles Fodya	University of the Witwatersrand	
Prof Alistair Forbes	NPL	
Miss Laura Gallimore	Oxford University	
Joe Gillard	DSTL	
Mr Artur Gower	NUI Galway	
Dr Scott Grandison	University of East Anglia	
Prof Alexander Guterman	Moscow State University	
Dr Cameron Hall	University of Oxford	
Dr Paul Hammerton	University of East Anglia	
Mr Matt Hennessy	University of Oxford	
Mr James Herterich	University of Oxford	
Mr Duncan Hewitt	University of Cambridge	
Dr Peter Hicks	University of Sheffield	
Mr Byron Jacobs	University of the Witwatersrand	
Miss Siân Jenkins	University of Bath	
Ms Dewei Jia	University of Oxford	
Mr Klemens Katterbauer	KAUST	
Mr Amir Kayani	Airbus	
Ms Tania Khaleque	University of Oxford	
Prof Giorgi Khimshiashvili	Ilia State University, Tbilisi	
Mr Aleksander Klimek	Polish Academy of Sciences	
Dr Vasyi Kovalchuk	Polish Academy of Sciences	
Dr Kamil Kulesza	Polish Academy of Sciences	

Name	Affiliation	Email
Prof Andrew Lacey	Heriot-Watt University	
Mr Kei Fong Lam	University of Warwick	
Rob Lamb	JBA Consulting	
Miss Georgina Lang	University of Oxford	
Dr Robert Leese	Industrial Mathematics KTN	
Mr Alexander Lewis	University of Oxford	
Mr Lorcan Mac Manus	Industrial Mathematics KTN	
Miss Melissa Maczka	University of Oxford	
Mrs Janella Mansell	AWE	
Dr Michael McCarthy	NPL	
Mr Andrew McCormick	Harvard	
Mr Andrey Melnik	University of Oxford	
Mr Iain Moyles	University of British Columbia	
Dr Paul Munday	Industrial Mathematics KTN	
Mr James Nally	DSTL	
Ms Aleksandra Niechcial	Polish Academy of Sciences	
Mr Stephen O'Keefe	University of Oxford	
Dr Hilary Ockendon	University of Oxford	
Prof John Ockendon	University of Oxford	
Dr Emilian Parau	University of East Anglia	
Dr Simon Parker	DSTL	
Dr Dhanesh Patel	MS University of Baroda	
Dr Rushen Patel	Industrial Maths KTN	
Ms Nimisha Pathak	MS University of Baroda	
Miss Natalie Pearson	Oxford University	
Ms Karina Piwarska	Polish Academy of Sciences	
Prof Colin Please	University of Southampton	
Dr Richard Purvis	University of East Anglia	
Dr Angel Manuel Ramos	Universidad Complutense de Madrid	
Mr Tom Ranner	University of Warwick	
Mike Redwood	DSTL	
Mr Moritz Reinhard	University of East Anglia	
Mr Paul Roberts	Oxford University	
Mr Parousia Rockstroh	Simon Fraser University	
Dr Zimei Rong	Essex University	
Mr John Schofield	University of East Anglia	
Ms Nilima Shah	MS University of Baroda	
Mr Zubin Siganporia	University of Oxford	
Mr Maciej Skorski	Polish Academy of Sciences	
Ms Kamila Slawinska	Polish Academy of Sciences	
Prof David Stevens	University of East Anglia	
Dr Heather Tewksbury	Industrial Mathematics KTN	
Mr Julian Thompson	University of East Anglia	
Mr Andrzej Tolarczyk	Polish Academy of Sciences	
Dr Jamal Uddin	University of Birmingham	
Mike Vaughan	Environment Agency	
Miss Ruth Voisey	University of Manchester	
Ms Ingrid von Glehn	University of Oxford	
Mr Martin Walters	University of East Anglia	
Miss Chang Wang	Oxford University	
Mr Yu Wang	KAUST	
Miss Emma Warneford	University of Oxford	
Eleanor Watson	Poikos	
Dr Robert Whittaker	University of East Anglia	
Dr David Wood	University of Warwick	
Ms Liyan Yu	University of Cambridge	
Ms Agnieszka Zelerowicz	Polish Academy of Sciences	
Dr Piotr Ziolo	Polish Academy of Sciences	