VVG network: Case for Support

1 Introduction

We propose a network with the aim of promoting the convergence of Computer Vision, Video Processing, and Computer Graphics. We name the network the "Vision, Video, and Graphics" (VVG) network. The motivation for the Network arose from a meeting at VVG'03, convened specifically to discuss ways to promote convergence in the UK.

The convergence area is emerging as a new and exciting field, raising basic questions for the academic community and commercial opportunities for the industrial community. The UK is very well placed to both research and develop the convergence area, for the strength of our academic community is matched by the presence of an advanced industrial sector: we boast high quality games, special effects, telecommunications and broadcast companies all of which understand the benefits of convergence.

The youth of the convergence area, and the strong position of the UK represent an excellent opportunity that we must act upon now, if it is not to slip away from us.

2 Aims and mechanisms

The convergence area is very broad. There is no underlying theory that drives it in a particular direction (we have no Grand Unification Theory). Whether such a direction will emerge in the future is a moot point so far as this proposal is concerned. We concentrate our interest on the following aims:

- supporting collaborative research relevant for the science and applications of convergence;

- promoting the visibility and importance of the convergence area;

- shape a cohesive group of UK research centers clearly identifiable at national and international level as a focus for convergence research.

The key implementation tools envisaged are academic exchanges (visits), and a national workshop.

2.1 Academic exchanges

The VVG network will fund the exchange of researchers between laboratories; from a Graphics to a Video lab, or from a Vision to a Graphics lab, for example.

In a typical scenario, senior researchers from each lab. will have agreed on aims and objectives of the exchange, costs, and so on. The VVG network cannot support these initial exchanges. A junior researcher (e.g. a RA or PhD student) will then visit, for a longer period of time, and work through the agreed programme. Senior staff may visit the exchange lab. — and such vists can be supported by the network. Exchanges between academic and industrial laboratories are also considered, provided that the companies involved contribute to the network's aims and objectives. Similar remarks apply to visits to institutions outside the UK. These are examples only, there is no intention to be prescriptive.

The network is intended to be as inclusive as possible. Anyone can participate, subject to the availability of funding; the initiative is meant for the benefit of the community at large. However, the network has to be administered, and so a steering committee is proposed that comprises the following people: Dr. Peter Hall (Bath), Prof. Phil Willis (Bath), Dr Adrian Hilton (Surrey), Dr. Emanuel Trucco (Herriot Watt), Prof. John Robinson (York), Dr Adrian Clarke (Essex).

The mechanism for an individual to acquire funds for exchange is modelled upon the responsive mode mechanisms run by EPSRC. A senior researcher applies for funding, we call this a *request*. The steering committee *reviews* from a number of reviewers. We have a long list of willing reviewers that represent all parts of convergence, and are drawn from both the academic and industrial communities. These include, but are not limited to: Dr Adam Baumberg (Cannon), Dr. Andrew Fitzgibbon (Oxford), Prof. Min Chen (Swansea), Dr. John Gilby (SIRA), Prof. Roger Hubbold (Manchester), Dr. Glenn Cross (Manchester), Dr. Jeremy Thorne (BT), Dr. Adrian Thomas (Exeter), Prof. Jian Jun Zhang (Bournemouth). My apologies to anyone who wishes to be on this list but does not appear — anyone is welcome to add their name by approaching any member of the steering committee. We may, at times, even call on international referees.

The funds themselves have to be held at a particular location, and we propose the PI's institute is a suitable place. The steering committee will appoint a secretary, a treasure, "area chairs" to seek and assess reviews, and to organise workshop and web dissemination.

At some pre-advertised time the committee discusses and orders all current requests, funding as many as possible. The requests and the meeting will, of course, be on a far smaller scale than EPSRC use, reflecting the fact that even the most expensive proposals are expected to be around £3500, but we will not be prescriptive. Furthermore, the majority of meetings will be email based: we aim to keep administration costs to a minimum. We propose this model because we believe it is fair, inclusive, and understood by the community.

2.2   Workshop and Web

Unlike the responsive mode grants, we do not propose a panel assessment on completion of an exchange. Instead we require the exchange participants to attend a VVG workshop run at the end of this proposal. The VVG network will fund accommodation, meals, room hire only, and the costs of assembling the proceedings. It will not fund travel costs because these are too variable.

The VVG workshop will not be peer reviewed; it is not possible to insist on both attendance and peer review. However, all delegates will submit a paper and make a presentation, and the papers will be assembled into coherent whole, most likely in the form of a CD ROM.

It is likely that this workshop will be associated with the VVG conference series, the first of which took place in Bath 2003, and was sponsored by the IMA. Such an assocation will help attendance as well as costs.

In addition, each exchange visitor is required to submit a web page to the VVG web site. This is currently maintained at Essex University.

3   Research issues

The nature of this proposal makes it impossible to formulate a detailed programme of research, as specific research themes must be proposed by exchange applicants. We think however important to identify here some research themes characterising the convergence area at present, and their relevance for applications. We reiterate that our list is not prescriptive, and that we shall welcome proposals on other topics deemed relevant for the network's aim by reviewers.

The list below relies on a variety of sources, including EPSRC event reports [1, 2, 5], an EPSRC consultation document [6], surveys on convergence and allied themes [4, 8], technical publications on a wealth of convergence topics (e.g., [7, 3]) and of course the proposers' own experience.

- **Image based rendering** IBR, generally speaking, points to a growing class of vision and graphics techniques aiming to generate realistic imagery and video without explicit CAD models [4]. The standard example is view synthesis, which, given at least two images of a scene, generates an image taken from a third viewpoint. Transferring the viewpoint in real time with a dynamic scene, maintaining photometric consistence, remains the subject of research in vision and graphics.

- **Immersive and augmented environments** Immersive communications span a wide spectrum of systems supporting various degrees of presence, that is, conveying an impression of presence

in a virtual or augmented environments. Important applications include collaborative decision-making in immersive environments like caves, design and manufacturing, and videoconferencing. Augmented environments are of particular interest, as video and CAD material must be composited together seamlessly in each frame. Substantial vision research exists, and more is needed, to devise stable solutions for the underlying technical problems, including truly robust tracking, multiview analysis, and surface reconstruction for vision, and realistic rendering with avatars or by IBR methods for graphics.

- **Video representation issues** Collaborative augmented environments require real-time exchange and processing of large amounts of multimedia data. This poses serious challenges in terms of hardware (discussed below), and, for IBR-oriented systems, in terms of representation of video shots. Such a representation should include shape and photometry information, support view synthesis with high video quality, and ideally be compatible with limited-bandwidth environments.

- **Advanced communications** Linked to representation is the problem of information reduction for transmission. This can be achieved by compression and coding, but it is arguable that geometric methods could improve efficiency. Other convergence-related communication themes include cross-platform and interoperable environments (e.g., videoconferencing connecting different terminals). Compression and coding are a wide research field in their own right; here, we are not interested in solutions *per se*, but in research clearly connected to convergence applications.

- **Geometric and photometric reconstruction** As objects and scenes to capture in computer models become increasingly complex (e.g., animals, people, scenes with many moving parts), manual model writing becomes increasingly unfeasible. Work exists on the automatic acquisition of 3-D shape and photometric models of objects (eg, people, indoors environments) from multiple views and from video shots. The purpose is often to support the generation of arbitrary-viewpoint sequences, or dynamic, panoramic mosaics (e.g., omnidirectional vision).

- **Shape and motion modelling** People are an especially important class of 3-D objects, unfortunately a very complex one. Recent research has established a solid base for the integration of vision (eg, stereo and multiview, surface reconsruction, view synthesis) and graphics techniques (e.g., texture processing, model-based rendering). Further work is necessary to devise models of the human body (including clothes) and its motion suitable for animation, virtual studios, special effects and film post-production, high-realism gaming, and virtual collaborative environments.

- **Hardware and systems issues** The need for capturing multiview, synchronised videos is pushing the development of new acquisition tools. Different solutions are available for different applications (from high-quality studio acquisition to Internet and home computing). The requirements of taxing applications like immersive videoconferencing, however, remains to be met. They impact also the the evolution of graphics hardware architectures (from polygon-based to pixel-based pipelines, meeting the IBR paradigm). Bandwidth is another important issue, especially given the increasing importance of mobile communications and platforms. The importance of these themes is indeed ubiquitous for convergence applications.

4 Management

The steering committee will be responsible for managing all aspects of the network. A *treasurer* will be responsible for administering finances, ensuring there are sufficient funds to meet requests. A *general secretary* will arrange meetings, including email meetings, between committee members. We will have three *area chairs* who will be responsible for receiving requests and allocating reviewers. An *academic workshop secretary* will organise the academic elements of the workshop (collect papers, produce CD ROM), while local organisers will arrange accommodation, meals, meeting rooms, etc.

In addition to these roles, the steering committee are charged with distributing funds for exchange visits. This is by far their most significant role. The role of the committee is not to define "convergence" in advance and allocate accordingly. Rather, the committee is under an obligation to accept definitions and terms of reference provided by the reviewers.

No member of the steering committee can review any request. Any request made by a committee member must be discussed in the usual way, with the conflicting member excluded. If a review secretary submits a request, then it must be through the one of the other review secretaries. All reviews will be unattributable.

The steering committee will maintain a list of reviewers. Anyone can forward their name and area of expertise to the steering committee. The list of reviewers will be published.

5   Dissemination

The network will be initially advertised to the graphics, vision and video research communities by email shots, by creating and maintaining a convergence website (vvg.essex.ac.uk), by announcements at standard conferences, such as BMVC, EGUK, IEE events. The committee as a whole will be responsible for initial dissemination, and for inviting, collecting and collating reviewer names, as well as any comments from the community. We will release this case for support as part of that initial dissemination, to help the community understand exactly what has been funded by the EPSRC. More compact material (e.g. posters, flyers) suitable for distribution at events will also be produced. Shortly after the official start date of the grant, the committe will meet to finalise terms (taking into account the community views not available at the time of writing this proposal). The community will be notified, and the network will have begun in earnest.

About half way through the grant period the committee will meet to review progress, including committee membership, reviewers membership, dissemination, the effectiveness of the exhanges, industrial involvement, strategic opportunities, links with other initiatives, and any other business that may arise. The minutes of this meeting will be made public on the VVG website, as will the minutes of all meetings.

All network exhanges must provide a page to be linked from the VVG web site, which is currently maintained at Essex University.

The final element of dissemination is the VVG workshop. The reason for holding a workshop is to present outcomes in public, but also to foster future exchanges. The committee will meet after the workshop to consider overall achievements and opportunities for the future. The committee will be in charge of producing a final report that will be made publically available. This will review the achievements of the network against the aims declared in this proposal, summarise research results, publications, and industrial involvement, discuss novel opportunities created (e.g., further grants propitiated, new industrial collaborations attracted, links with any strategic funding programme arising), and include lists of exchanges sponsored and reviewers.

6   Beneficiaries

The network is meant to benefit primarily the research community. Consequently, the success of the proposal can be crudely measured by the number of peer reviewed publications produced as a direct result of the exchanges, and the number of future proposals propitiated. Such measurables will be made publically available, in association with the exchange requests that produced them (all successful exhange requests will be made public).

Further, important benefit for the community is an increased cohesion of the convergence community in the UK, and an increased awareness and involvement of the industrial sector in concergence research.

7   Justification of resources

The figures given here are approximate. They are based on current known costs, extrapolated for inflation over two years.

VVG network exchange costs

A senior research is expcted to travel and stay one or two weeks. The junior researcher will stay for longer period of time, say 3 months on average. Exchanges will be fully funded. The expected average cost per exchange between two institutions:

Senior researcher £500
Junior researcher £3000
Subtotal £3500

VVG workshop costs per delegate
Each exchange must send at least one delegate to the workshop:
CD ROM proceedings £0.40
2 nights accommodation £150
meals £20
Subtotal £170.40

The total expected cost per exchange/delegate is £3670.40

Additional fixed costs
There are fixed costs associated with the network. In particular the steering committee will have to meet physically from time to time, to initiate the network, discuss progress, and organise the workshop. In particular they will meet initially to finalise procedures, about half-way through to review progress, and at the end to review the overall initiative. These meeting will be fully funded. In addition, The workshop will have to hire a room to meet in.
Steering committee meetings £3000
2-day room hire for workshop £400
Subtotal £3400

The number of funded exchanges
The network allows funding to £60,000. The above costs are appoximations, based in recent experience of the PI (organising VVG'03), and take inflationinto account. Therefore we can fund about

$$15 = \left\lfloor \frac{60000 - 3400}{3670.4} \right\rfloor$$

exchanges. The network will last for two years, and we argue that 15 is a reasonable number of exchanges over this period.

References

[1] M. Hylton: *The convergence of graphics, video and graphics.* EPSRC workshop report, April 2002.

[2] M. Hylton: *Challenge of convergence exhibition.* EPSRC theme day report, July 2003.

[3] P. Hall and P. Willis (eds): Proc. IMA Intern. Workshop on Vision, Video and Graphics, Bath, July 2003.

[4] J Lengyel: *The convergence of graphics and vision.* IEEE Computer, July 1998, pp 46–53.

[5] *Machine vision and image processing.* EPSRC theme day report, June 2000.

[6] M. Hylton: *The Convergence of graphics, video and vision.* EPSRC consultation document, 2002.

[7] G Solina and R Bajcsy (eds.): Proc. NATO advanced workshop on the confluence of computer vision and computer graphics, Kluwer, 2000.

[8] E Trucco and F Isgró: *Computer vision in the future of communications.* BMVA 2002 tutorial.