

## Meeting 1 Report – Daresbury Laboratory

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The inaugural UK Fluids Network Smoothed Particle Hydrodynamics (SPH) Special Interest Group (SIG) was held at STFC's Daresbury Laboratory in Warrington on the 12<sup>th</sup> of July 2017.



The following SIG members were present at the meeting (by organisation):

**STFC:** Gregory Cartland-Glover (GCC); Xiaohu Guo (XG); Stephen Longshaw (SML); Sergi Siso (SS); Alex Skillen (AS)

**The University of Manchester:** Annelie Baines (AB); Alex Chow (AC); Aaron English (AE); Steven Lind (SL); Benedict Rogers (BR); Georgios Fourtakas (GF)

**Digital Engineering & Test Centre:** Samuele De Guido (SDG)

**Brunel University London:** Tom De Vuyst (TDV)

**Heriot-Watt University:** Yeaw Chu Lee (YCL)

**Simpact Engineering:** David Lemouton (DL); Karol Tomczyk (KT)

**The University of Aberdeen:** Mehrdad Manzari (MM)

**The University of Bristol:** Thomas Rendall (TR)

**IBM Research:** Malgorzata Zimon

The meeting saw an agenda that included thirteen technical presentations given around SPH, followed by an animated and useful guided discussion around a number of key topics: *The Future*

of the SPH SIG, SPH & Industrial Work-Flows and SPH Research. A synopsis of this discussion can be found in section 2 of this document.

## 1.0 Technical Presentations

Stephen Longshaw (STFC): *SPH for the Virtual Product*

Benedict Rogers (Univ. o. Manchester): *SPH at the University of Manchester and SPHERIC updates*

Alex Skillen (STFC): *SPH as Part of a General Coupling Framework*

Sergi Siso (STFC): *SPH on the latest many-core Xeon Phi Architectures*

Alex Chow (Univ. o. Manchester): *A fast I-SPH solver for free-surface flows on the GPU*

Xiaohu Guo (STFC): *Massively Parallel I-SPH*

Thomas Rendall (Univ. o. Bristol): *SPH at the University of Bristol*

Steven Lind (Univ. o. Manchester): *SPH and Shifting: A Review and Reflections*

Yeaw Chu Lee (Heriot-Watt Univ.): *Surface Tension Dominated Flows with SPH*

Tom De Vuyst (Brunel Univ. London): *SPH at Brunel University*

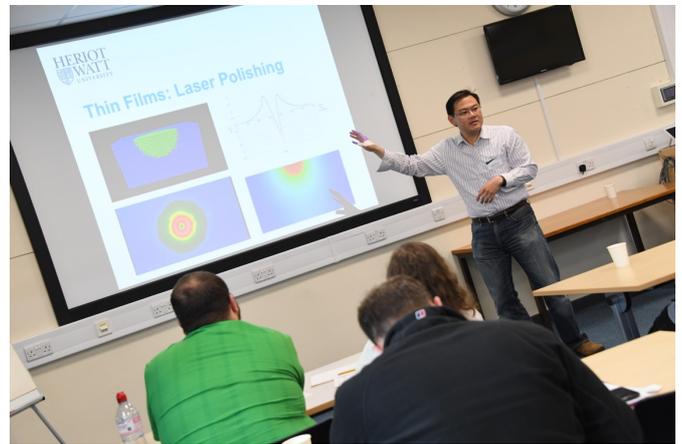
Mehrdad Manzari (Univ. Aberdeen): *Study of Debris Flows Using SPH*

Luke Mason (STFC): *High-velocity Coatings Using SPH*

Samuele De Guido (DETC): *SPH and the Digital Engineering Test Centre*



Steve Lind (Univ. of Manchester) presents the topic of particle shifting within the SPH community.



Yeaw Chu Lee (Heriot-Watt Univ.) showing work on laser polishing with SPH.

## 2.0 Guided Discussion

The final event of the first SPH SIG meeting saw Luke Mason (STFC) chair a discussion session around a number of pre-decided general questions on various aspects deemed currently important to the UK SPH community and the SIG itself.

As this was the first meeting of the SPH SIG, the first topic was what the SIG should try to achieve and how it can do that over the coming 24 months. *The following responses are para-phrased and re-ordered based on notes taken by Stephen Longshaw, for a reference of name acronyms, please see the list earlier in this document of attendees.*

Note: SPHERIC stands for SPH European Interest Community

**BR:** There appear to be too many academics in attendance at the first meeting compared to those from industry.

**SML:** The SIG itself has a number of industrial members who were unable to physically make the meeting though are available through the mailing list.

**SL:** UK Fluid Network SIGs should aim for a 10-year legacy in their respective areas. For SPH, the research community itself is fairly well-knitted, however industry is not, tending to be involved in SPH through internal projects only. The SIG could aim for a legacy built around better industrial dissemination.

**SML:** Suggestion of industry focussed future SIG event hosted by DETC through SDG.

**SL:** Suggestion of the same idea but focussed on bringing other scientific disciplines that are not typically associated with SPH, so a different, more academic focus but with the same idea of demonstrating SPH to those who are not currently aware and wouldn't tend to go to a specialist meeting like SPHERIC.

**YCL:** Suggestion of incorporating practical SPH coding and simulation exercise into a future SIG event.

**SL:** For the industrial event, could provide a "questions and answers" affair where industry pose problems and challenges and then the SIG responds with potential solutions using SPH after a period of reflection.

**BDR:** Suggestion (followed by consensus) that the next SIG event could be the academic-outreach event proposed by SL in around April 2018, followed by the industrial event proposed by SML and hosted by DETC in September 2018.

Discussion then naturally moved to the next major question of how SPH currently fits with industry and their work-flows and what can be done to improve this.

**SML:** The SIG should aim to find where SPH fits into existing industrial work-flows and make sure it shouts about this and ways that SPH can be incorporated. If this doesn't exist then then the SIG needs to define it.

**BDR:** How does the SIG get industry to talk about their software, what they use and how they use it? Very hard to work out where they are deficient without this.

**BDR:** Industrial involvement in SPH is now paramount. As a practical computational method, it relies on real-world applications of importance to gather academic funding. One cannot exist without the other. Point also made by SDG.

**AC:** SPHERIC community spends lots of effort proving SPH works as described. Are these cases relevant for industry and if not, what would be?

**KT:** In most industrial cases, they don't care what method they use, it is speed of solution and business gain as well as reliability.

**MZ:** Does industry know about SPH software and if so, are they confident in it?

**BDR:** SPH as a flow solver is not as mature as some other methods and therefore neither are its tools, some basic proofs are still outstanding. This should come from the academic community but the basic questions need to be driven by industry.

**AB:** Organisations like the DETC can help in getting the SPH community represented by the SPH SIG, together with industry.

**SDG:** The SIG needs to find the sectors that most needs SPH but perhaps doesn't yet know it. Automotive industry DETC links to seems a good candidate.

**AB:** SPHERIC community has good web presence for academics, but not what industry may need or feel comfortable approaching. Could the SIG help set something up that is more suitable for demonstrating SPH for industry?

**KT:** Often industrial users will decide whether to accept a solution based on it being able to solve a test use case they provide, not based on problems provided by the respective community.

**TDV:** A real difficulty getting industry to take up use of software they do not know. Should SPH be targeted as new capabilities in those frameworks or pushed as new solvers as it currently is? Hard to know what best way forward is.

**BDR:** The problem with industry using outdated SPH implementations in existing software packages is the method moves very quickly, they therefore use old, slow implementations, get poor results and write SPH off as a method when in fact it is the badly implemented module of their software package that is to blame and using a cutting-edge research development environment would provide far superior results.

**GF:** The SIG should take responsibility of advertising the modelling capability of different software packages in a way that industry can consume.

**LM:** One strength of SPH is that, as a less developed and accepted method its cutting-edge developments can be focussed towards new and emerging computing technology, meaning the resultant solvers are more future proof.

**MZ:** Computing architectures currently designed by IBM use GPU accelerators at their heart. If SPH solvers align themselves with this sort of design and embrace it then it is likely they will be the best performing on the HPC systems of the future.

**XG:** Usability of academic codes is nearly always worse than industrial counterparts yet they often resolve the physics of a problem better and use modern computing hardware better. The challenge is how to get industry to see this and to look beyond software marketed to them and also to explore ways to bring the usability of current SPH solvers to standards where they interest industry.

At this point the majority of the available hour had been used, however a few comments were made regarding the third topic of SPH research in academia:

**AB:** While SPH is currently primarily used in a few scientific disciplines such as engineering and astronomy, the applications themselves can naturally lead to links with other areas of science. For example, when performing an SPH engineering study of flow past an array of tidal turbines, there is a natural link to Earth Science where deposition is of interest.

**SML:** Finding the links within academic disciplines is imperative as SPH needs to break its funding requests away from EPSRC and out to other councils. This is especially important with the formation of UK Research & Innovation in 2018 where cross-discipline research will be key.

**BDR:** Academic communities using or developing SPH in the UK need to come together and focus efforts as one groups use-case can be a seed for another's different but interesting developments. The SIG should be a vessel for this.

## 2.1 Key Discussion Results

The key points from the very useful discussion for the SIG to take forward are:

- We will aim to hold another 3 meetings before September 2019:
  - The first will be in approximately April 2018 (location TBD) and aim to engage other scientific disciplines.
  - The second in September 2018 (hosted by DETC at Loughborough) and aim to engage industry.
  - The third will be at a time between July and September 2019, depending upon SIG availability, and will be a focus back on UK SPH research and development with the goal of running a student dissemination event and also a repeat of meeting 1 but with the hope that meetings 2 and 3 will mean a larger spread of members.
- There is a clear appetite for the SIG to be used to help an existing SPH community within the UK to engage with UK industry.
- There is also a desire for SPH software efforts within the UK to be clarified and their capabilities and development harmonised and disseminated.

- It is clear that the SIG will be a very useful platform to ensure different SPH research groups around the UK are aware of each other's work and will facilitate working relationships.