MArkerless lung target Tracking CHallenge (MATCH)

Interview with Marco Mueller, the coordinator

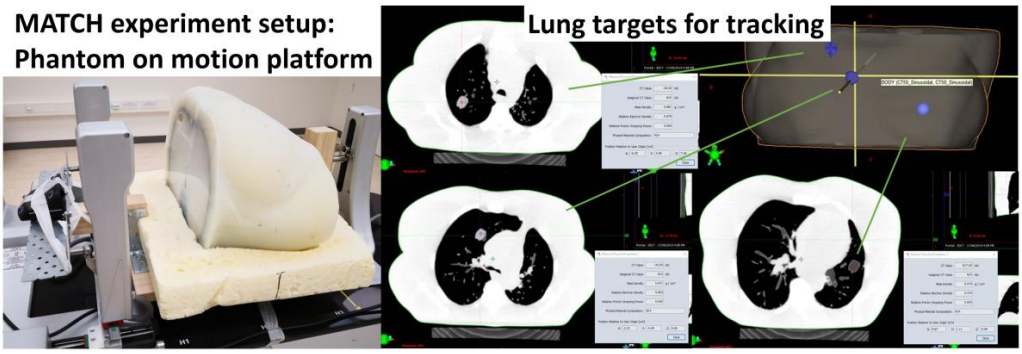
What is the scope of your PhD project, and how did the MATCH fit into it?

The scope of my PhD is the translation of markerless tumour tracking (MTT) into clinical use on conventional radiotherapy systems. Currently, lung cancer treatment efficacy is limited by the fact that patients move, breathe, and their hearts beat, all of which cause motion of the tumours and healthy tissue during imaging and treatment.. This may result in under-dosage of the tumour and over-dosage of the healthy tissues. MTT can be used to track tumour motion using a standard kV-imager and advanced image-processing technologies directly at the time that it is needed most – during delivery of radiation treatment and without the need for surgical intervention. MTT is an affordable technology that is compatible with 95% of existing radiotherapy systems.

As we approached clinical implementation of MTT in 2019, we needed to address the classic steps of commissioning and quality assurance. However, there was no comparable technology, so we reached out to the international medical physics community to ask for help to make a robust set of benchmarks and guidelines. Therefore, the MATCH blends perfectly with my research. Also, the organisation of a project on such an international scale at PhD level was an outstanding opportunity for my personal development and it offered an experience that I didn't want to miss.

What is the scope of the MATCH and how does it differentiate from other challenges? What makes it special?

The MATCH is special because it was the first *experimental* American Association of Physicists in Medicine (AAPM) Grand Challenge – yes, it involved the shipment of an experimental setup around the world during a global pandemic. The need for motion management in radiotherapy has fostered the development of many MTT approaches, from the development of specialised multi-million-dollar treatment machines to pre-clinical approaches using conventional treatment systems. However, these approaches have yet to be benchmarked using a common measurement methodology and that is the knowledge gap we want to fill with the MATCH. The challenge for the participants was to track the tumour during a lung-cancer treatment that was simulated in a phantom study, which we created to be as close to a real clinical scenario as possible. To fit as many approaches under the umbrella as possible, the MATCH was divided into two parts: a retrospective in-silico study and a prospective experimental study. Participants could sign up for either one or both.

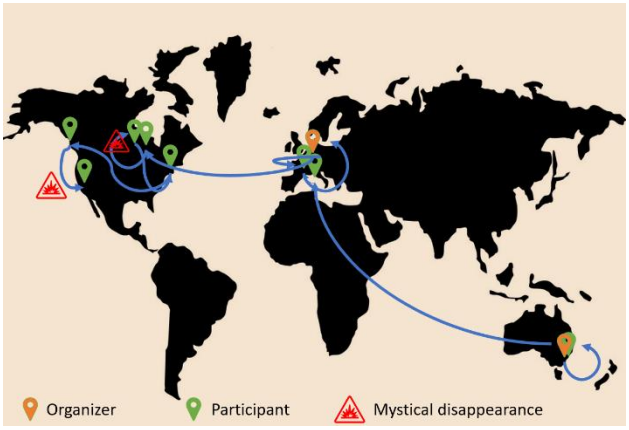


Experimental setup

What were the difficulties with the challenge from the organising perspective? How did Covid-19 impact the challenge?

Covid-19 certainly impacted the MATCH in multiple ways. The shipment of clinical equipment between hospitals and a global pandemic don't mix very well. Covid-19 measures were adjusted often and it was hard to plan more than two weeks before most of the experiments. Several participants had to withdraw from the challenge due to restrictions that were in place on site or the limited research resources that were available to them at the time.

Also, (very expensive) parts of the experiment setup were lost twice and they reappeared damaged two weeks later. A few problems occurred down the line; e.g., at first, we did not have sufficient motion stages to conduct the experiments simultaneously at multiple centres. Luckily, we received very much appreciated help from the company Scandidos, which supplied our participants with a HexaMotion stage for use over the time of the experiments. Looking back now, although many unexpected difficulties occurred, we could always find a way out and now we have many stories to tell.



Tracking movement of the equipment

Was it difficult to find participants? How did you do the marketing? Was there interest from the industry?

At first, we doubted whether we could find enough interest in the community. However, to our surprise, more than 20 participants signed up within the first week of the announcement of the challenge in the AAPM newsletter. We used multiple channels to draw the attention of potential participants and we received most registrations after the publication of the AAPM newsletter. The large associations have a great reach! We also identified potential participants by scanning the abstracts of past AAPM conferences for the keywords 'markerless tracking' and then we actively contacted the institutions we found. I was very glad to see that the MATCH received interest from researchers in the industry, who either participated themselves or who strongly supported clinics that used their companies' products. However, not all participants were able to continue to the result submission stage.

Where do you see the weak points in MATCH?

The main limitation of the experimental study was the use of a 3D-printed anthropomorphic phantom which meant that accurate tracking of the motion in this phantom was necessary but not sufficient to demonstrate clinical utility.. If anyone who reads this can offer a deformable thorax phantom with reproducible motion, please contact me!

Furthermore, the simulated workflow in the in-silico study was very specific and therefore the participants had to devise MTT approaches that were tailored to work with this problem. On the one hand, this was intentional, because the workflow was supposed to be very close to that encountered in a clinical scenario. On the other hand, we may have lost many participants here.

Can you talk about the outcomes of the MATCH, personally and scientifically?

In the experimental study, we benchmarked three clinical MTT systems from five participants plus six pre-clinical approaches and we received four result submissions for the in-silico study. The major preliminary outcome we found was that treatment that used MTT was always superior to treatment that used no motion adaptation at all. That's a very strong selling point for MTT, because MTT comes with almost no additional costs and risks to the patient, so why not just use it? At this stage, I cannot talk about the results and ranking of the participants' approaches. We will announce the results in an AAPM webinar on 28 January, 2021. I look forward to seeing you there!

For me personally, coordination of the MATCH was a great experience, certainly one of the highlights of my PhD. I really learned to appreciate working with our research community, industry, and clinics to achieve a common goal. I also learned to appreciate that level of responsibility, which at the beginning was new to me, and to learn from the problems that had to be solved whenever something did not work out as expected. I learned that running a challenge is a lot of work and some things will go wrong, but ultimately the outcome is worth it.

Do you think the European SocieTy for Radiotherapy and Oncology (ESTRO) could profit from organising similar challenges? Where do you see the difficulties and benefits?

Definitely! Many important questions must be asked during translation of science and evidence into clinical practice and a challenge provides a unique opportunity to bring all radiotherapy professions together to find a competitive solution. This not only results in an impactful outcome, but it also fosters collaboration and important knowledge exchange across many professions. ESTRO has a renowned reputation across Europe and the world; the hosting by ESTRO of a challenge would be a step towards the fulfilment of its vision for 2030: to be ambitious, expansive, inclusive and open to the future. I can recommend to ESTRO that it give those who are interested in hosting a challenge the chance to do so, e.g. by being open to challenge proposals. I bet that many researchers will be encouraged to take the opportunity.

For your future career, do you want to continue with this challenge or maybe even organise a new one?

The MATCH will continue as a live challenge after the announcement of the outcomes and will allow benchmarking of future MTT approaches. We will make the dataset and ground truth available publicly and institutions will be able to conduct the original MATCH experiments on request. If running a challenge was ever in line with my research goals again, I wouldn't hesitate to start one. Once I had conquered the fear of doing something new, it was just a lot of fun. But as always in research, I won't limit myself to a method, but rather do whatever brings me closer to an impactful research outcome.

Can you give three tips to researchers who may consider organising a challenge like MATCH?

Firstly, establish easy two-way communication channels between organisers and participants. These will prove very useful down the line when something unexpected happens, as you will want to find out about the issue as quickly as possible. Secondly, make the challenge for the participants as straightforward as possible, but also find the balance to clinical applicability. This way you lose few participants during the challenge and maintain the focus on an impactful outcome. Lastly, I want to encourage all of us to win our own challenges within ourselves; the challenges that hold us back from trying something new. Inaction breeds doubt and fear. Action breeds confidence and courage. If you want to conquer resistance, do not sit back and think about it. Seek discomfort and enjoy creating an impact through trying something new. Maybe, through the design of a Grand Challenge with ESTRO.

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