

Interview with Dr Frank Van Diggelen, winner of the 2021 Harold Spencer Jones Medal



Dr Frank van Diggelen from Google was awarded the prestigious medal from the RIN for his pioneering role in the delivery of ubiquitous smartphone navigation. Google has created a smartphone Global Navigation Satellite System (GNSS) competition (see below), and here we present an interview with Frank about Raw Measurements from phones.

Q: Can you say a few words about your role at Google?

A: My team and I develop indoor and outdoor location technology for Android. Simply put: we make the Blue Dot ever more accurate on Google Maps (and all other location-based apps).

Q: What are Android Raw GNSS Measurements?

A: The basic measurements made by the GNSS chip in an

Android phone.

Q: Why are these important and what is the idea behind doing this?

A: These measurements make the blue dot more accurate and reliable.

The principal idea is to help phone manufacturers improve GNSS performance, by having access to the fundamental measurements from the GNSS chip. Think of the engineers monitoring the data from an F1 car - they can see exactly what's going on with the engine, and how changes affect performance - something similar is true for each new Android phone design. Android is the most widely used operating system ever - and there are over one thousand different Android phone models. So we have to empower the engineers who are designing GNSS into all those phones.

There are two significant side-benefits of the Raw GNSS Measurements:

- They provide researchers and developers access to almost everything from the GNSS chip, and
- They have great pedagogical value: students studying GNSS can see, for the first time, the fundamental measurements made by a GNSS chip - this is not pseudorange, by the way, pseudorange is a value derived from the raw measurement of received satellite time.

Q: Can you share some of the innovations which have already been made possible by opening GNSS raw measurements?

A: From third party researchers we've seen tremendous interest and progress in Real-time kinematic positioning (RTK) from phones. Carrier-phase positioning is the oldest commercial use of GNSS (e.g. Trimble Navigation was doing this in the 1980s), but to make RTK work in a phone is something new and exciting.

Competition Time!

Google announces the Smartphone Decimeter Challenge. Participation in the competition is open to everyone. To be eligible for cash prizes, participants must register for the ION GNSS+ 2021 conference and present their results at the conference. Winners will present their results in the ION GNSS+ 2021 conference session «HIGH PRECISION GNSS POSITIONING ON SMARTPHONES COMPETITION». Competitors wanting a peer-reviewed version of their results to appear in the conference proceedings are required to have full results and accompanying paper submitted per competition and conference guidelines. Training dataset and ground truth can be downloaded from Kaggle website. For more information, see g.co/gnssTools.



Internally, at Google, we have made use of raw GNSS measurements, with 3D Map Assistance, to solve the urban GNSS accuracy problem caused by blocked-and-reflected signals that are the norm near tall buildings.

Q: What are the key enablers for true indoor navigation?

A: WiFi RTT (Round Trip Timing), and MEMS (microelectromechanical systems) motion sensors. You can make GNSS receivers work indoors, by increasing the receiver sensitivity in well-known ways; but accuracy is awful because a satellite signal finds its way indoors through countless different paths. Indoor location from outdoor wireless is a bad idea. What you want are reliable transmitters that are inside with you: WiFi Access Points (APs). The IEEE 802.11 (WiFi) standard has evolved to include Round Trip Timing, so we can measure distance

from APs with one-meter accuracy. And just like you can get GNSS measurements from Android phones, you can get WiFi measurements too.

Q: Can you foresee a time when our devices will not rely on GNSS for location?

A: No. Even though I just explained WiFi RTT, that's for indoor location. And anyway, WiFi APs are located in the first place by survey, or SLAM (Simultaneous Localisation and Mapping), techniques, each anchored in GNSS. There is some hype around cold-atom inertial sensors. This technology will eventually be viable for everyday use. Hundreds of years from now (assuming we solve climate change, and are still around), our descendants will have chip-scale sensors that track their movements with exquisite precision over many hours, days, or weeks. Those sensors will still initialize their location using some form of GNSS.



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The General Lighthouse Authorities of the United Kingdom and Ireland (GLA) are at the forefront in the provision of safety-critical marine aids-to-navigation. The GLA consist of Trinity House (for England, Wales, the Channel Islands and Gibraltar), The Northern Lighthouse Board (for Scotland and the Isle of Man) and the Commissioners of Irish Lights (for the whole of the Island of Ireland). GLA Research and Development (GRAD) is a crucial area for us as we drive cutting-edge projects of global significance in the marine environment comprising satellite and terrestrial radio navigation systems, alongside physical and visual signalling systems.

This role is an exciting opportunity to join our internationally-renowned GRAD team employed by Trinity House, and working on behalf of all three GLA, applying your skills and knowledge for the benefit and safety of all mariners. You will work at our modern, waterside offices that offer good transport links to London and beyond. There will also be some travel to GLA locations around the United Kingdom and Ireland, with some international travel.

You will pilot and deliver strategic, conceptual, systems, technology and business-related studies, plans, proposals

and trials, including procuring and managing external support as required. You will also seek and secure external project & funding opportunities that influence and leverage support for key future GLA initiatives. You will develop and maintain strategic external relationships and collaborations nationally and internationally that inform GLA strategy and strengthen engagement for future navigational safety developments. You will produce briefing notes and papers for internal and external meetings and conferences and represent GRAD and the GLA through meetings, networking and conferences.

You will be highly numerate with a good degree in engineering, systems engineering, mathematics or physical sciences. You should have practical experience of the systems engineering lifecycle, including requirements capture, design, development, and implementation and testing. Some business development skills are also desirable, as is experience in playing a pivotal role when participating in multi-disciplinary national and international projects.

Ideally, you will have some industrial experience, but you will definitely be adaptable, self-assured and enthusiastic with

excellent interpersonal skills and the ability to communicate effectively (both written and orally) at all levels. Good organisation and time management skills are essential, as are well-developed IT skills. Project Management skills are also desirable.

If you are interested in this opportunity and keen to bring your skills and experience to our GRAD team, please visit our website www.trinityhouse.co.uk/vacancies to download the job description and complete the online application form.

As an equal opportunities employer, Trinity House is committed to the equal treatment of all current and prospective employees and does not condone discrimination on the basis of age, disability, sex, sexual orientation, pregnancy and maternity, race or ethnicity, religion or belief, gender identity, or marriage and civil partnership. We aspire to have a diverse and inclusive workplace and strongly encourage suitably qualified applicants from a wide range of backgrounds, to apply.

**Application to be received by
midnight on Monday 12 July 2021**

**Interviews to be held in Harwich on
w/c 26 July 2021.**