Indoor Positioning

Wouldn't it be great if we could find our way around anywhere and at any time using a small in our hand, pocket or bag? What a relief it would be to know that we couldn't get lost when arriving at a railway station in a foreign city…positioning would be an ongoing process, and the voice of our digital guide would pilot us through corridors, and up and down stairs and escalators, as easily as if we were checking emails on our smartphone. Alas, a universal positioning system that operates in all conditions and is unaffected by the type of land use does not exist. Even outdoor positioning by GNSS is faulty, since signals may get blocked or scattered when we move through an urban canyon or an avenue flanked by trees with dense foliage.

High-fidelity indoor positioning is crucial for those who have to work under extreme conditions, such as firemen and medical staff attending a building fire. And that's why a lot of researchers are working hard to find positioning methods and technologies suitable for use in high-rise office blocks, shopping malls or other expansive buildings.

IPSs (Indoor Positioning Systems) can be divided into two broad groups: autonomous systems, which can operate without support from any external device, and contingent systems, which need receipt of signals emitted by external devices. To the first group belong inertial navigation systems, magnetic field sensors and barometers. Mounting such sensors in handhelds requires miniaturisation. However, the output of small sensors is often contaminated with heavy noise leading to low accuracy. Contingent sensors, meanwhile, rely on wirelessly detecting signals – either electromagnetic or ultra-sonic – emitted by devices of which the (relative) position is known. Basically, four components of a signal can be measured: phase, strength, angle and travel time. The latter is also called 'time of flight' or 'time (difference) of arrival'. But what is the best choice of method and sensors?

When designing or using an IPS, certain features need to be scrutinised. Essential are systematic and random errors, as they define how well the location – expressed in coordinates, words or icons – can be fixed. A rule of thumb: the higher the accuracy, the higher the costs will be. Accurate location may also entail increased complexity, which may in turn reduce robustness and hence introduce a higher failure rate.

The decision about methods and tools may also depend on the sensor infrastructure present in the building in question. Many buildings in hazard-prone areas may be poorly equipped with devices that enable positioning, if at all. Such buildings require different IPS solutions from those which have a rigorous sensor infrastructure based on Wi-Fi, WLAN, GSM or UWB, for example. One thing is for sure: the creation of reliable, robust, user-friendly and affordable IPSs will be directed towards integration of multiple sensors, both autonomous and contingent, in small devices going hand in hand with launching IPS infrastructures.