



Building solutions for defence

Tessella's experience covers algorithm development and signal processing for sophisticated radar systems; developing models and software tools for quantitative risk assessment; and designing inertial tracking systems. This allows us to provide excellent mathematical and software solutions to the defence industry.

The global defence industry pushes the boundaries of technological developments and presents ever-changing challenges in an evolving market. Solving problems for defence organisations takes strong skills and capabilities and high quality, adaptable staff.

Defence work covers a very broad range of disciplines, and Tessella has built up in-depth experience in a number of technical areas, through projects carried out over many years. Particular areas of expertise include:

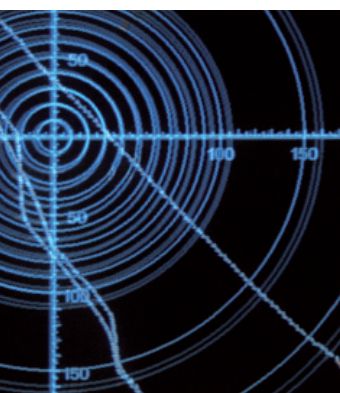
- Radar tracking algorithms and modelling
- Radar signal processing
- Navigation and inertial tracking
- Risk and consequence analysis

Tessella provides excellent solutions from both technical and software viewpoints. Staff can work on-site with clients, providing software, mathematical, statistical and engineering skills of the highest quality. Staff with clearance to SC level can be provided.

Tessella is an approved holder of the MOD Framework Agreement for Technical Support (FATS/3) and a member of a defence Consortium for the provision of Information Systems/Information Technology Applications and Software Development consultancy. Tessella is also an approved Catalyst supplier to the public sector purchasing framework. These three contracts are managed and supported from our Stevenage office.

Our approach to developing effective solutions draws on a range of skills, including:

- Design and analysis of complex systems
- Systems engineering
- Control theory
- Mathematical modelling and simulation
- Software development
- Mathematical and statistical analysis
- Estimation theory
- Algorithm design and assessment



Radar tracking

Tessella has created algorithms and performed modelling work for a number of radar projects. These have included ground, air and ship-based radars, reflector antennas, and phased-array radars such as SAMPSON, the radar built by BAE Systems Inyeste for the new Type 45 Destroyer. Tessella's tracking algorithm and modelling experience includes:

- Multi-function radar tracking
 - Track extractor design and analysis
 - Design and analysis of track smoothing algorithms
 - Analysis of track false alarm rates and derivation of track initiation rules
 - Design and performance analysis under computational load
 - Plot-track association algorithm design and analysis
 - Design and analysis of clutter mapping algorithms
 - Track extractor interface definition
 - Development of complete track extractor and radar simulation to derive closed-loop performance
- Track-while-scan radar tracking
 - Track extractor development for naval early warning system
 - Algorithm analysis and derivation for track extractor processes
 - Track smoothing algorithm development
 - Tracking algorithms for manoeuvring targets, including multiple hypothesis methods
 - Processing requirements for primary and secondary radar returns
 - Plot-track association analysis
 - Track initiation, fade and deletion analysis and algorithm development
- Clutter density measurement algorithms
 - Measurement of very low clutter densities
 - Resolution of localized high-density clutter regions
 - Project-specific tuning and optimization
- Advanced multipath compensation algorithms
 - Development of sea-surface multipath compensation algorithms
 - Extension of existing published techniques, increasing performance

Radar signal processing

Support to design and performance modelling of surveillance and tracking radar systems, covering:

- Digital beam-forming and monopulse measurements
- Anti-multipath and anti-jamming techniques
- Receiver gain control and detection threshold control
- Constant False Alarm Rate (CFAR) algorithms and resolution performance
- Range / Doppler profile extraction
- Timing issues and data flows in signal processing software and firmware

Navigation and inertial tracking

Expertise in data fusion of inertial and a variety of other positioning systems, including:

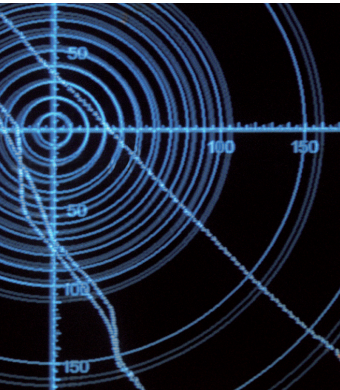
- Development of advanced inertial tracking solutions for dismounted soldiers
 - Combining inertial and GPS data
 - Combat-mode motions (uneven running, crawling)
- High-accuracy pedestrian tracking using advanced Kalman filtering techniques developed in-house
- Data fusion for navigation solutions
- Trade-off studies in autonomous land vehicle navigation, merging inertial, GPS, visual and wheel-based sensors
- Missile guidance, navigation and control
- System-level trade-off studies for safety critical positioning systems using multiple INS and GPS sensors

Software development

Tessella have delivered many software development projects to the defence industry, including:

- Software and database development to support management of communications modelling data
- Building detailed simulation environments for radar tracking
- Design and development of software tools to support quantitative risk assessment

We have extensive experience of writing scientific and engineering programs within a rigorous quality system. All Tessella activity is performed within our TickIT quality management system, accredited by the BSI to BS EN ISO 9001.



Risk analysis

Tessella's expertise in decision analysis and risk analysis has been combined with software engineering, modelling and physics skills to provide significant support to the UK MOD Defence Ordnance Safety Group (DOSG). Work has included:

- Validation and verification of consequence models used to assess the risks arising from accidental initiation of stored explosives, and development of improved models
- Modelling the trajectories of fragments of ordnance and building debris resulting from accidental detonations
- Graphical output methods to help to visualise and compare different risks (such as the example shown below)
- Development of new software tools to support Quantitative Risk Assessment (QRA) of sites where ordnance is stored and also more general hazard assessment for MOD projects
- Support to all stages of the software development lifecycle including requirements definition, interface design, development, testing and deployment

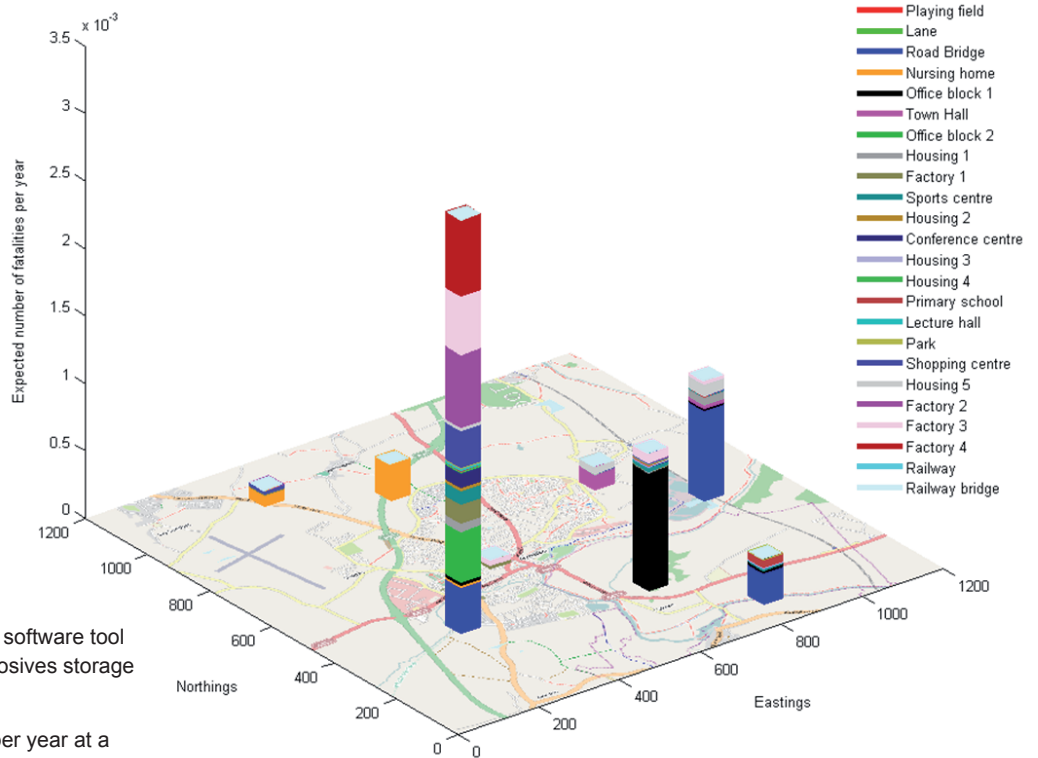
Safety case analysis

Tessella's wide range of expertise has been used to support MBDA in preparing the safety case for the CAMM missile.

- Design and implementation of a simulation of a missile drop trial
- Support with drop trial planning and design to maximise the useful data obtained
- Detailed analysis of trial results to extract deformation profiles, including sensor data and video image processing, and correlation with the model
- Mathematically rigorous extrapolation of the trial results to the real deck scenario
- Use of model for prediction over a wider parametric envelope

Device modelling

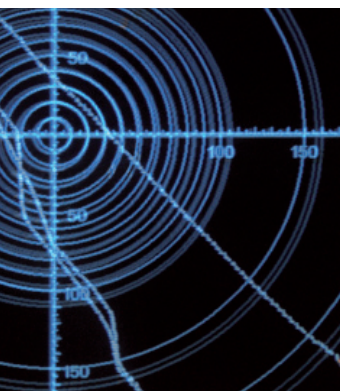
- Sensor modelling and requirements analysis
- Hardware device modelling and analysis at analytical level without resorting to full finite-element analysis



Graphical output from a Tessella risk analysis software tool used for quantitative risk assessment for explosives storage sites:

Expectation value of the number of fatalities per year at a number of sites where people live or work (represented by the different colours) due to various potential explosive sites (the towers, shown at their actual locations on the map).

All data shown here is fictional



Algorithm development

Tessella have worked on algorithm development and analysis projects across the defence sector:

- Adaptation of data fusion algorithms which combine the output of a number of detectors for chemical or biological agents in order to determine the source, current position and likely future behaviour of the threat
- Investigating techniques for parallel or distributed data fusion, for faster execution and increased robustness by removing the risk of a single point of failure
- Techniques to identify optimal sensor placement, through surrogate modelling of the data fusion system
- Network analysis and modelling routines for a major defence client to improve and expand their network analysis toolbox
- Data analysis and processing to generate representative sample infrastructure networks for analysis
- Developing and testing new algorithms, refactoring existing algorithms
- Integration within an evolutionary network optimisation routine
- Modelling of network interdependencies

Digital archiving

Today's intelligence-gathering methods can produce vast amounts of data. As the world leaders in digital archiving technology, Tessella can help defence organisations with:

- Identifying the drivers for archiving
- Categorizing the data storage needs
- Specifying the security requirements
- Investigating how users will search and access the contents of the archive

- Exploring how the archive integrates with operational systems
- Selecting, planning and deploying the appropriate software solution

We can provide integration and customisation of off-the-shelf archiving solutions, including our own Safety Deposit Box (SDB) technology, or develop a bespoke solution.

Tessella's experience in archiving includes creation of long-term archiving systems for the UK National Archives (TNA) and equivalent bodies in the Netherlands, USA, Switzerland and Malaysia, and work for the UK Houses of Parliament, JET, Pfizer and Syngenta.

Asset Management

Proactive servicing helps to keep assets economically operational for as long as possible, and achieve reliability, availability, maintainability and safety. Tessella has created asset management systems which provide:

- Data acquisition – capturing information about the status of the asset being monitored
- Data analysis – inferring the current state of the asset from the acquired data and predicting its future state
- Updating of the Asset Register – capture the results of monitoring into a central data store
- Decision support – advising a course of action based upon the analysed data
- Investment strategy – developing and implementing an appropriate strategy for maintenance and renewal

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