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In depth: COMPIT 2019

COMPIT comes of age

Nick Danese reports on proceedings at this year's Conference on Computer Applications and Information Technology in the Maritime Industries conference, and notes a growing maturity in attitudes towards the role of computing in ship design

The 18th iteration of COMPIT marked a coming of age for this unique, research-focused conference, tirelessly orchestrated by the timeless Volker Bertram. The country gentleman's, discretely plush Tullamore's Bridge House Hotel was the perfect set for the occasion, very well celebrated by the variety of papers coming from four continents.

Perhaps, an in-step coming-of-age in the industry may have taken place, too: quasi-absent triple integrals and partial derivatives with imaginary numbers were replaced by a somewhat sobering recurrence of the notion that Artificial Intelligence (AI) and Autonomous Ships are still products of human programming and, hence, not human-error free by definition. One may wonder whether the current AI paradigm used in word processors to auto-complete, auto-correct and translate by affinity is to be considered a representative preview of coming events. LEAN, AGILE, Gartner Hype Cycle and progressive PLM implementation based on a solid Business Process Assessment were finally discussed beyond the confines of SSI's Denis Morais' precursor presentations of previous years. Even neural networks and the Pareto Frontier - applied to PLM implementation, of all things (!) - have been polished up on the background of the widening, and luckily now finally seen by many, generation gap.

The very commercial and long-term notion of total cost of ownership of complete processes – as opposed to that of just products - was discussed, if not the focus of more than one paper, and the Generative Design to real structure example presented might have very well have been the first theory-to-practice effort of its kind in this industry. Also, from a very *applied* research angle, discussion on how to palliate the absence of legislative and regulatory guidelines and rules when it comes to designing and operating autonomous vessels – autonomous being a definition presented as unclear at best – highlighted the issue of the huge and growing technological progress/law gap to the commercial world, opening a whole new branch of marine, non-engineering research.

In a quasi-first principles approach, freely available AIS data is being used in new ways to enhance both the forensic and the predictive digital twin and applied to the analysis of ship navigation patterns and to collision prevention.

On the other hand, the question is raised of whether some may be missing the very forward looking COMPIT mission statement. For example, results of research in the multi-author, distributed, collaborative, multi-platform, etc. environments – an established reality in so many other industries - questions the long-term added value of work carried out by the 'major' software houses to incorporate modern technology, including but not limited to AI, into their arguably monolithic legacy programs.

One may also argue the relative short *vs* long term value of efforts aimed at composing a diversified, collaborative environment made up of legacy software produced by a geographically compact group of companies, an approach which does not exorcise the lamented multiple file conversion, one of several plagues, and exploits state-of-the-art technology in a rather limited fashion. It was pointed out (again) that we are "several years behind", and a little web searching confirms that breakthroughs announced in our industry are often well established technology and practices in other sectors. In parallel, at least one author proposed a truly agnostic self-explanatory format already used by many and available to all to create a truly open data environment with intrinsic connectivity to ERP and PLM databases of all kinds.

Going on a start-up buying spree *à la* GAFAM (Google, Amazon, Facebook, Apple and Microsoft) may not be advisable, but one cannot ignore the growing influence of technologically advanced mainstream companies well present in our industry, either.

Irrespective of opinion, throughout three days of assorted sessions all papers were undeniably interesting, informative and in more than one case, instructive.

ZEN and the art of CA ship design

Gaspar's 'A perspective on the present, past and future of computer aided ship design' describes how advances in CASD (Computer Aided Ship Design) solved many practical issues but also how unfortunately these solutions are not implemented at the enterprise level or made to share common data sets. Rather, they remain a disparate collection of niches of ever more specialised software applications sporting limited data exchange capabilities. Moreover, *Gaspar* notes how the complexity of setting up and implementing a PLM system is compounded by a fragmented IT scenario, cultural resistance to change and a widening generation gap. The effort spent to make it all work causes resources to be wasted in data conversion therefore not available to critical design work components.

Siemen's *Sears et al.* discussed the use of Model Based Enterprise strategy with Product Breakdown Structure logic to support engineering-to-order, similarly to industry standard products like ShipWeight (weight/CG estimation) and CostFact (cost estimation).

Bole introduced hull design as an AGILE design tool and *Hollister* presented 'OpenCalc - an Open Source Programming Framework for Engineering', a remarkably agnostic, pragmatic and ubiquitous approach to the free-for-all exploitation of distributed and collaborative environments. Using XML files, author-specific data of any kind is intrinsically documented via the embedded and human-readable schema, making it directly available to any consumer, be this a person, a program, a machine, a dashboard or a process. Also fundamental in a non-proprietary, distributed scenario, by definition this approach makes available weakly redundant data sets. For example, same-type data produced by different authoring tools can be chosen from by individual consumers as a function of the use to be made of the data itself.

Optimisers do it better

Sobey et al. compared legacy and modern genetic algorithms of specialized and generalized types on structural optimization and internal layout problems, the clear winner overall being the cMLSGA of 2018. *Van Dijk et al.* reported how 'Automatic Selection of an Optimal Power Plant Configuration' now involves not only overall propulsion efficiency but also alternative fuels, clients' preferences. The algorithm indicates fuel cells are the preferred but still a higher cost option. *Harries et al.* detailed progress in the 40-plus team working on the *Holiship* initiative to build a CAESES-based flexible design platform aimed at creating a "synthesis model in a bottom-up approach".

All simulations great and small

Goodwin et al. illustrated the practical application of generative design to a real structural component taking into account changing constraints. Similarly, *Donohue et al*. approached a General Arrangement design by the probabilistic mapping of dependencies between layout and system configurations. This approach matches very well the still very ignored functional design requirements of nowadays, heavily system-laden ships. In 'Discrete Event Simulation for Strategic Shipyard Planning' *Min et al.* approach the overall shipyard problem via a process-centric simulation, improving productivity by facility expansion and layout changes.

VR-Tigo

Gaming technology (finally) enter industry : *Spencer et al.* depart from commonly used, high cost mainstream VR strategies to build *ShipSpace*, a significantly lower cost, very high performance and realistic VR environment via Head Mounted Displays employing VR collaboration tools, the use of which in an up to 64 participants environment is illustrated by *Goh*, who also lists a number of ensuing tangible benefits. *Van der Tas et al.* examined CFD analysis results in full-immersion VR, while *Cassar et al.* use VR to support Human Factor

Engineering by identifying and accounting for crew requirements, constraints and limitations, be they objective or subjective.

Come Together [,technologies]

Ommani et al. present an iterative ship-digital twin model strategy allowing for *what-if* studies and operational changes in the context of a simulation-based decision support system aimed at an offshore platform's station keeping. They also highlight a core issue of simulation, that it how to replace simulation components with newer ones, or add more, while preserving the reliability of the process overall. *Sieranski et al.* discussed the relative merit of implementing a Best of Breed approach that makes use of distinct, specialized tools but might result in a discontinuous design process vs a monolithic, all in one, less discipline specialized systems delivering a lesser quality overall result, the preference going to the fomer. *Seppäla* revisited a paper*less* scenario in "Drawingless Production in Digital Data-Driven Shipbuilding", reporting significant reduction in the paper documents required by the shipyard after adopting electronic viewers and highlighting that "CAD . . . is an example of how a small innovation became the backbone of the regime . . . it can become the cradle for all IT systems . . . ", a platform-centric view (CAD in this case) different from *Hollister*'s.

Digital Twin

Huikkonen et al. combine AIS and other public weather data coupled with structural models to estimate remaining ship structure fatigue cycles using 3D panel methods and FE analysis, while *Drazen et al.* compose a "System of Systems" digital model to increase situational awareness and predict future ship condition and performance. From an IIoT (industrial internet of things) perspective, *Nowak et al.* use on-shore digital models to improve and design new, on-board edge analytics in an iterative process. Poignantly, they point out that sensors and gauges must be located appropriately and of the highest reliability.

Tutti Frutti

Colling et al. documented constraints and costs of applying platooning to river trains, and another look at crew reduction (in Easy-Jet style) by automating navigation tasks was taken by *Kooji et al.* *Deul et al.* proposed an expert system to depart from the *by-weight* paradigm and assist in capturing the rationale, reasoning and decision-making process in estimating the cost of ship structure. *Herrero et al.* reviewed various main stream AI initiatives in detail, with special attention paid to Autodesk's Dreamcatcher and the IBM/Foran-cognitive engine.

Seeing eye-to-eye with AI

Stensrud et al. described constraints in applying machine learning to drone inspections in low-light, GPS-denied environments with the sobering insight that more data may lead to worse results. *Weymouth* improves 'Roll Damping Prediction Using Physics-Based Machine Learning' by up to 200% using a very scarce training set, a notable development in solving a very computational-intensive problem. A first, *Chatzikokolakis, et al.* propose to generate alerts by using AIS data to statistically detect anomalous navigational behaviour of ships.

Digital Training

Bertram et al. provided a comprehensive overview of the many digital training options available and conclude that classroom training remains a valid option, too, as many digital option are made unfeasible by cost or ineffective by the very human nature of those undergoing training. *Kil et al.* developed virtual training scenarios based on the ISM code using a VR gaming multiplayer supporting platform, to which *Schmidt et al.* add student / instructor roles allowing for scenario changes on the fly, reminiscent of sci-fi movies.

Smooth Operator

Like *Hollister*, *Cady* proposes an agnostic and autonomous microservice architecture based on asynchronous communications via message queues, advocating the use of hi-tech common-place Chaos Engineering for troubleshooting. This approach might well evolve into a condition or prediction based adaptive service environment and fits very well with *Hollister*'s data model's architecture. Combining AIS and hindcast weather data with parametric resistance estimation, *Son et al.* estimated the fuel consumption of a meaningful set of ships and documented the very measurable waste of fuel due to the navigational *rush-to-wait*. *Erikstad* proposed continuous on-board motions and slamming monitoring to support operational decisions, while *Uzun et al.* computed the Total Cost of Ownership, down to the factory's carbon production, of using antifouling paints.

Uncommonly and equally realistically, *Porathe* proposes that AI and machine learning should be a time-unlimited, andromorphic process, one of the goals being computers learning *awareness*. *Wahlström et al*. follow with a discussion on whether machine learning and AI can actually become capable of "taking perspective" and "feeling" a situation, a basic feature of social cognition present in human decision-making. *Berge et al.* as well as *Steidel et al.* proposed collision avoidance strategies combining anticipation of the other ship's action and data exchange between ships leading to negotiation-capable, safer autonomous ships.

Unmanned Ships on the Horizon

Eriksen's very interesting and somewhat metaphysical discussion of "what is autonomy", really, and by corollary an autonomous ship highlighted that humans remain in the loop from programming of AI algorithms to remote control. In this respect. *Walther et al.* studied the requirements of supporting increased situational awareness in tug operation eventually leading to effective remote control. Similarly, *Yan et al.* discussed applying AI to steer unmanned passenger ferries across the very densely busy Yang-Tze river. The AI operator is supported by combined on-shore and on-board navigational data that provides an extended situational awareness. This already in-use AI system is of particular interest because it creates an immersive, augmented awareness scenario used by the AI operator and AR-monitored by on-shore human achieved by synchronizing and streaming field data collected from geographically distinct sources using a variety of technologies, very possibly a first of its kind. Might this be not that far a cry from the on-call, physical weight-supporting holograms seen in 'Black Panther" ?

About the author

Nick Danese is the founder of Nick Danese Applied Research (NDAR), a consultancy specialising in Business Process Assessments, Implementation Consulting and engineering system integration of software such as ShipConstructor, MAESTRO, ShipWeight, Express Marine GHS and Navisworks in distributed, collaborative environments. He regularly presents at events on of ship design and construction.