Formation Flying: What's Coming Up ?

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Formation Flying will require major breakthroughs in the space sector. But not only in space technology; in several other domains, the cards might be substantially reshuffled. This paper focuses on related coming technological and programmatic evolutions that touch in some way the simulation domain. These evolutions can be seen through several programmes and R&D projects where Spacebel is involved.

Some of the PRISMA Phase 0/A studies generate models that will be incorporated in the flight software. This seems the beginning of the trend where Phase 0 studies result in substantial parts used in the flight software and the operational simulators. Formation flights have n satellites, each of them having more intelligent subsystems. Processors will run in the 100 to 200 MHz range, within a couple of years in multi-core configurations. The era of generating computers (Systems on a chip) on a "as needed" and project basis is approaching. Positioning systems have relatively little heritage, so more basic testing need be done with substantial more equipment. The role of the prime changes as he has the responsibility of integrating more subsystems, each delivered with its own set of models and simulators, from more providers. Not only the agility of the formation flight is at stake; the agility of the development teams will become a major factor, especially in terms of concurrent engineering and regenerating quickly new simulation and test configurations.

Concurrent engineering for Phase 0 is becoming possible, even with rather sophisticated modelling. Public domain 3D visualisation tools such as Celestia, can now be integrated with simulators in days, integrate new satellite designs in hours. A first radical improvement is needed in flexibility and configurability. The ultimate "universal" database is still progressing; SMP2 and Space System Reference Architectures announce a first level of reusability. Data modelling and exchange tools such as BEST and OASIS, along with its internal XIF format as source for DEDSL and XTCE, as a first step towards further (semi-)automatic simulator and test system generation. SCICOS (SCILAB), the HMI design tool in CNES' BASILES, becomes a bridge between study and operational simulators, possibly extended with SMP2 simulator generation. Multi-thread, multi-processor and clustered systems, potentially helped by HLA(-light) solutions, should allow for improved performance and reconfigurability, without changes to neither the models nor the simulators. Distributed hybrid simulated and hardware test systems with deterministic hard-real time characteristics in the µsec range are becoming possible with mainstream PC's and OS's. A CNES "separability" study is going on to investigate the separability of subsystems and their parallel simulation. Automated identification of potential parallel simulation capability might become possible. Processor simulators should gain a five to ten-fold performance increase in the coming years.