

Progress in ATC Simulation 1991-2006

The year 1991...Intel releases the 486SX processor chip, Microsoft announces Visual Basic for the Windows 3.0 operating system only released the previous year, Linus Torvalds makes his Linux OS available, and the World Wide Web is opened to the public. In hindsight all were significant milestones in the growth of computer technology to which the simulation industry is intrinsically locked. In the fifteen years since these events, ATC simulation certainly has come a long way.

Just where were we back then? The aims were pretty much the same as they are today; improve the quality of the learning experience, while reducing training times and costs. The vision was to narrow the gap between what could be accomplished through simulation and what had to be done with on-the-job training. It was well recognized that subjecting trainees to "live" traffic had two significant shortcomings; weather and traffic conditions could not be effectively matched to the stage of training, inevitably extending qualification periods, and there was an ever present downside to operational efficiency and safety. Perhaps the major difference between then and now is that what was true in 1991 is an even greater concern in today's much busier air traffic environment.

In many respects, ATC simulation in 1991 was still in its infancy. Capable radar simulators were in operation at many training institutions, but cheaper versions that could be deployed on a PC had only recently emerged and were just starting to gain a foothold in the market. By their nature radar systems do not demand the intense graphics associated with tower out-the-window views; a characteristic that made the development of early radar computer simulators a less daunting task than the development of a tower counterpart.

Most tower simulations were still fairly archaic by today's standards. The days of the table-top trainer were numbered, but not entirely over. Decent 2D computerized systems were the first to enter the scene. These tools were useful in teaching basic concepts, but they lacked the fidelity needed to foster spatial orientation and proper scanning techniques, crucial to effective tower training. Initially, only those agencies fortunate enough to have very deep pockets could even contemplate moving into the 3D tower realm. A situation that was rendered, so to speak, by the high cost of the complex image generation systems required to project the visual scenes.



NASA Ames Future Flight Central circa 1999

Over the past fifteen years Moore's Law of computer power evolution has been right on the mark...computer technology has advanced in leaps and bounds while, costs have shrunk dramatically. Processing speed, memory size, and reliability have all played a key part in promoting the growth of simulation. Clearly the advent of microprocessor capabilities enabled highly sophisticated systems to be deployed on COTS PC hardware. In turn, this expanded the horizons for ATC simulation training, enabling more extensive use both in schoolhouses and operational theatres.

Looking back, there were two particularly important occurrences that changed the face of ATC simulation. The first was the remarkable achievements in computer generated graphics and PC based visual processing technologies. This enabled the expensive specialized image generators to be replaced by COTS PCIGs at a fraction of the price. Not only do today's PC systems boast photo realistic 3D scenes and models, but they also sport enough processing power to generate traffic levels consistent with the busiest airports in the world. Insufficient targets were a common limitation of the earlier image generators.

The second instance was not an advance in technology, but rather an event that sparked innovation that remains paramount to the future of aviation simulation today. This event was the launch of the United States Air Force tower simulation program in 2001. The Air Force purchased 90 tower simulators under a contract which was awarded to Adacel. In addition to requiring that the trainees be immersed in realistic visual, environmental and operational situations, it marked the first time that the overriding requirement specified a system capable of being driven entirely by voice commands rather than pseudo pilot inputs. This was a landmark event because it spearheaded development on two fronts; (1) the effective implementation of speech recognition technology to the complex ATC environment and (2) the application of improved artificial intelligence techniques (AI) to create automatic, realistic pilot behaviour since there would be no pseudo pilots to compensate for inadequacies in simulator functionality.



USAF Tower Simulation System circa 2002 – first exclusive application of ATC speech recognition

Ironically, a rapid leap in technology is somewhat of a double-edged sword in the simulation world. While it vastly improves what can be offered, it also expands what needs to be offered. The real world has not stood idly by waiting for simulation to catch up. Advances in technology have and will continue to foster a plethora of tools aimed at improving information to aid the controller's decision making process. Many of these tools are increasingly dependant on automatic electronic communication between on-board aircraft systems and ground stations. Whether in the radar or tower world, the level of fidelity needed to close the gap between simulation and on-the-job training will dictate that these applications be incorporated.

Other key advancements of the past fifteen years will undoubtedly continue to grow. Visual system performance will become even better with improved resolutions and more detail in the dynamic effects associated to vehicles and environmental conditions. Further boosts to processing power and better system architectures will enable more sophisticated emulation of automated pilot behaviour particularly in the way they interact with the simulated world around them.



Adacel's MaxSim Tower displayed on Equipe's seamless curved screens – ATC Maastricht 2006

Arguably visual system advances contributed the largest economies to buyers during the last fifteen years; speech recognition is poised to surpass those savings within the next fifteen. As speech technology develops it will become increasingly possible to automate not just aircraft responses, but the whole world of adjacent coordinating agencies around a single training position. Speech recognition already provides training institutions the unique opportunity to offer more hands-on on time to more students with far less overhead from a supporting cast. The advantages will become irresistible in the future.

The recurring theme in ATC simulation is realism, realism, realism. As technology marches relentlessly onwards, it appears that the sky is literally the limit!

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