This academic year, a new Master track has been introduced at our faculty. The Flight Performance and Propulsion (FPP) track is developed following recent changes in the faculty on both an organizational and educational level. This column elaborates on the role the new track plays within the faculty.

Dr. Ir. Mark Voskuijl, Flight Performance & Propulsion Master Track Coordinator

The main areas of interest of the new track are flight performance and propulsion, with a focus on advanced/innovative aircraft configurations and novel propulsion concepts. Hence, aircraft engine integration is also an important topic. These research areas are highly relevant if we want to contribute to the ambitious targets proposed by the Advisory Committee for Aeronautics Research in Europe (ACARE). I therefore believe that our group can play an important role in the faculty as a whole. The heart of this Master track consists of four enthusiastic young assistant professors, namely Dr. Arvind Rao, Dr. Gianfranco La Rocca, Dr. Roelof Vos and myself, with Prof. Hester Bijl as acting head of the group. Each of us has a different expertise, varying from air-breathing propulsion systems, to flight mechanics and aircraft design and integration. In addition, important contributions in terms of expertise and a direct link to the industry, are provided by professors van Tooren, van Buijtenen and Torenbeek, who are part-time members of FPP. Moreover, we have about 15 PhD students who are working on a variety of research projects and contributing to the educational activity.

Setting up a whole new educational program is clearly a demanding task. The current track is therefore largely based on existing courses and only has one profile at the moment. It is our objective for the future to also introduce a second profile with a focus on propulsion and to tailor the set of courses that we offer to the students. Perhaps the most important part of the Master track is the final year, where the students have to conduct research for their Master thesis. This is where all the knowledge from the first year can be put into practice and where students can actively take part in our research. This is why I would like to highlight some of the current research projects to give you a flavour of what is going on in our group.

Work is currently being performed in various international research projects. Let’s start with one fascinating project called AHEAD (Advanced Hybrid Engine for Aircraft Design), which has started this October. It is anticipated that with the decreasing availability of fossil fuels, aviation will see a significant use of non-conventional fuels starting with synthetic fuels and biofuels and perhaps on the longer term hydrogen-rich fuels. Such a change obviously influences the propulsion system design and this is why my colleague Dr. Arvind Rao conceived a new engine configuration designated the ‘hybrid engine’. This hybrid configuration has two combustion chambers such that it is able to burn both liquid hydrogen and synthetic/biofuel at the same time. Such
an engine could bridge the gap between the current engines seen in civil aviation and future engines. Liquid hydrogen has a relatively large volume and needs to be stored in pressurized tanks on-board the aircraft. The choice of a hybrid engine therefore directly affects the overall aircraft configuration. The main objective is therefore to develop the novel engine for a Blended Wing Body aircraft, which inherently has a large internal volume compared to the conventional tube-and-wing concept. Our group has the lead in the AHEAD project which involves several international partners. Clearly, airframe-engine integration is a new focus point of our group.

Another European Commission-sponsored project that has just started where the FPP group is going to play an important role is RECREATE (Research on a Cruiser Enabled Air Transport Environment). This project is all about pioneering the air transport of the future. It aims at the introduction of the so-called cruiser/feeder concept in the second half of this century. This is an out-of-the-box transport concept, which can be thought of as an airborne metro system around the globe. Large cruisers transport passengers over long distances, while remaining airborne for very long periods, while passengers, supplies and waste are transported between the local airport and the cruiser by feeder aircraft locally. The design of innovative vehicles and their operations will be the main tasks for the FPP group, in collaboration with the Air Transport & Operations (ATO) chair colleagues.

The third project I would like to highlight is the Smart Fixed Wing project, funded by the European Union. One of the main objectives is to develop an all new smart wing design which has 25% less aerodynamic drag compared to a conventional wing by means of improved laminar flow and a reduction in aircraft weight. Improved laminar flow is expected to be achieved by passive and active flow control technologies integrated in the wing. Our group is mainly involved in the sub-system design and the integration of all novel sub-systems in the wing. In the end, it is the aim to assess the impact of the smart fixed wing on the overall aircraft performance. This is a demanding task which requires extensive use of novel design methodologies.

We encourage students to take part in these challenging research projects because we believe students can learn a lot by participating in an international research environment in collaboration with the aerospace industry. Last but not least we also believe that students can contribute with their open mind, enthusiasm and novel ideas. We are happy to observe that there already is a large interest by the students in our new group.

Clearly it is important that we, as a group, try to establish and maintain strong links with the aerospace industry, research institutes and other universities. Currently we are in close collaboration with Fokker Aerostructures and Fokker Elmo, the German Aerospace Laboratory (DLR) and the Israel Institute of Technology Technion just to name a few. We also see a shift towards more close collaboration with the emerging Chinese aviation industry in terms of education and research. Recently workshops took place both in China as in Delft to promote collaboration in those fields. It is fascinating to observe that the Chinese aviation industry is working hard to develop new aircraft and to improve their capabilities in the current economic climate. As an initial result of our collaboration, we can already see growing numbers of Chinese PhD students.

As a concluding remark, I can only say that it is a privilege to be part of such an exciting new group.