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"Dissemination and exploitation plan"
.

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Name of Author(s)   :   W. Haase

Organisation   :   WHAC – consultant to
CFD Software GmbH
Max-Loew-Str. 14 A
85579 Neubiberg, Germany
Tel. +49-(0)89-20038027
E-mail: whac@haa.se

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1 Introduction

The present deliverable provides an updated dissemination and exploitation plan based on current knowledge, i.e. at mid-term of the Go4Hybrid project. It is not suggested that major changed will apply to this plan, but in case important ones will arise, a further update will be issued.

2 The general plans - in alignment with the Technical Annex (DoW)

The Go4Hybrid project, incorporating industry (SMEs), research institutes and one university focuses on the solution of accurate, reliable and robust computational fluid dynamics (CFD) applications in the general framework of hybrid RANS-LES methods.

The *strategic goals* have been defined as follows:

The Go4Hybrid project aims to foster aeronautics RTD work in Europe by recognising merits and achievements of previous and existing EU projects. The project follows the ACARE Vision-2020 and Flightpath-2050 future strategies, by contributing to "more affordable, safer, cleaner, quieter", hence greener aircraft. In particular in the field of computational fluid dynamics (CFD), nowadays applied extensively in all aerodynamic-based topics of aircraft design, the Go4Hybrid project supports the European research policy and contributes to improving the competitiveness of the European aeronautics industry. This will be achieved by a close collaboration between the partners of the project and by directing the proposed work to ensure a focus on industrial requirements. By means of improved scientific capabilities and prediction tools with a high Technology Readiness Level aiming at improved confidence when using hybrid RANS-LES methods, Go4Hybrid will allow for enhanced design processes by mitigating the "Grey Area" problem. Consequently, this will result in fewer design cycles, lower costs and reduced time-to-market of challenging future aircraft designs.

This goal holds for all partners involved and in particular for the two *Small and Medium Enterprises* (SMEs), with one co-ordinating the project, CFDB, and the second coming from a so-called Non-European country", NTS in Russia. These partners with their own highly skilled personnel and their access - via Go4Hybrid - to highly improved aerodynamic simulation tools will foster and exploit their expertise in CFD both on a local and a trans-national basis. Clearly, this will directly improve *dissemination* of highly advanced computational tools.

The *research organisations* taking part in Go4Hybrid will directly exploit the knowledge gained in the project by improving their tools for further use in other projects and at the same time contribute to the dissemination by providing these improved tools to their current and future partners in industry and academia. In general, it is well-known that industry relies more and more on tools developed by research agencies, hence their contributions will be disseminated "ad-hoc" for the sake of the European aeronautical industries. Additionally, the corresponding know-how will be disseminated by young scientists and engineers, which are currently educated in these organisations.

Apart from directly using the experience gained for teaching and training students and researchers, they will be made more competitive on and for a professional market in which expertise in the numerical simulation of unsteady turbulent flows is getting more and more important for a large variety of applications (interior flows in engines, chemical facilities, exterior flows around cars, trains, aircraft, etc.). Thus, the project outcome will allow *universities* to pursue their goals in the field of aerodynamics both in research and in teaching. Universities, in particular, will receive an enhanced understanding for the industrial needs and will, combining dissemination and exploitation, educate students and young researchers in that respect.

In turn, this will not only lead to an advanced education of people that is taking care of the industrial requirements, it will, moreover, make (future) *employment in industry* more efficient and easy.

Last but not least, the big "group of observers", Bombardier, GE, NUMECA, EDF, PSA, RRD, Saab, ANSYS and VW will have access to technical information and will be allowed to provide own results. Evidently, the observer group opens another important door to dissemination and even exploitation.

During run-time, a tenth observer was accepted by the consortium. This is EXA, a company working in particular on Lattice Boltzmann approaches. Their interest goes beyond being a "passive" observer, they promised to work on a few test cases themselves and to provide openly their results for comparison with the consortium partners' results. This is a clear "added value" and will help to establish a better understanding f the EXA approach for the consortium as well as in turn improved knowledge for EXA with respect to handling of turbulence, extended wall models in PowerFLOW and improvements in accuracy and reduction of numerical dissipation.

EXA's motivation to join Go4Hybrid is related to the technical importance of hybrid modelling to industrial applications, the access to well validated flow cases, the evaluation of today state-of-the-art Hybrid CFD computations in terms of accuracy and speed for both fundamental and real world applications and the exchange of ideas on modelling and physics related to the "grey-area" flow regime – together with an expected improvements on hybrid modelling approaches.

Exa are prevented by company policy from revealing the precise formulation of a few key terms in their proprietary hybrid turbulence modelling approach. However, the suggestion was made by CFDB that EXA provide snapshots of eddy viscosity, thereby allowing partners to deduce e.g. in which regions the model acts as RANS and LES. EXA agreed to this suggested "workaround".

In addition, there are two so-called "Associate Partners", CASSIDIAN and EUROCOPTER, who have provided test cases – but are not allowed to participate in technical meeting and don't have access to the technical outcome. They will solely receive a report with summarised results on their test case – and did not sign any cooperation agreement. Nevertheless they belong to the area for dissemination and exploitation although in a somewhat limited sense. Both "associated partners" were invited to the kick-off meeting in order get a more precise overview about the Go4Hybrid project. Unfortunately, only EUROCOPTER participated.

3　　A structure for dissemination and exploitation

The following sketch, see Fig. 1, provides an graphical interpretation of Go4Hybrid's general dissemination and exploitation structure. This will allow omitting long lasting comments and, thus, will be more transparent and self-explanatory.
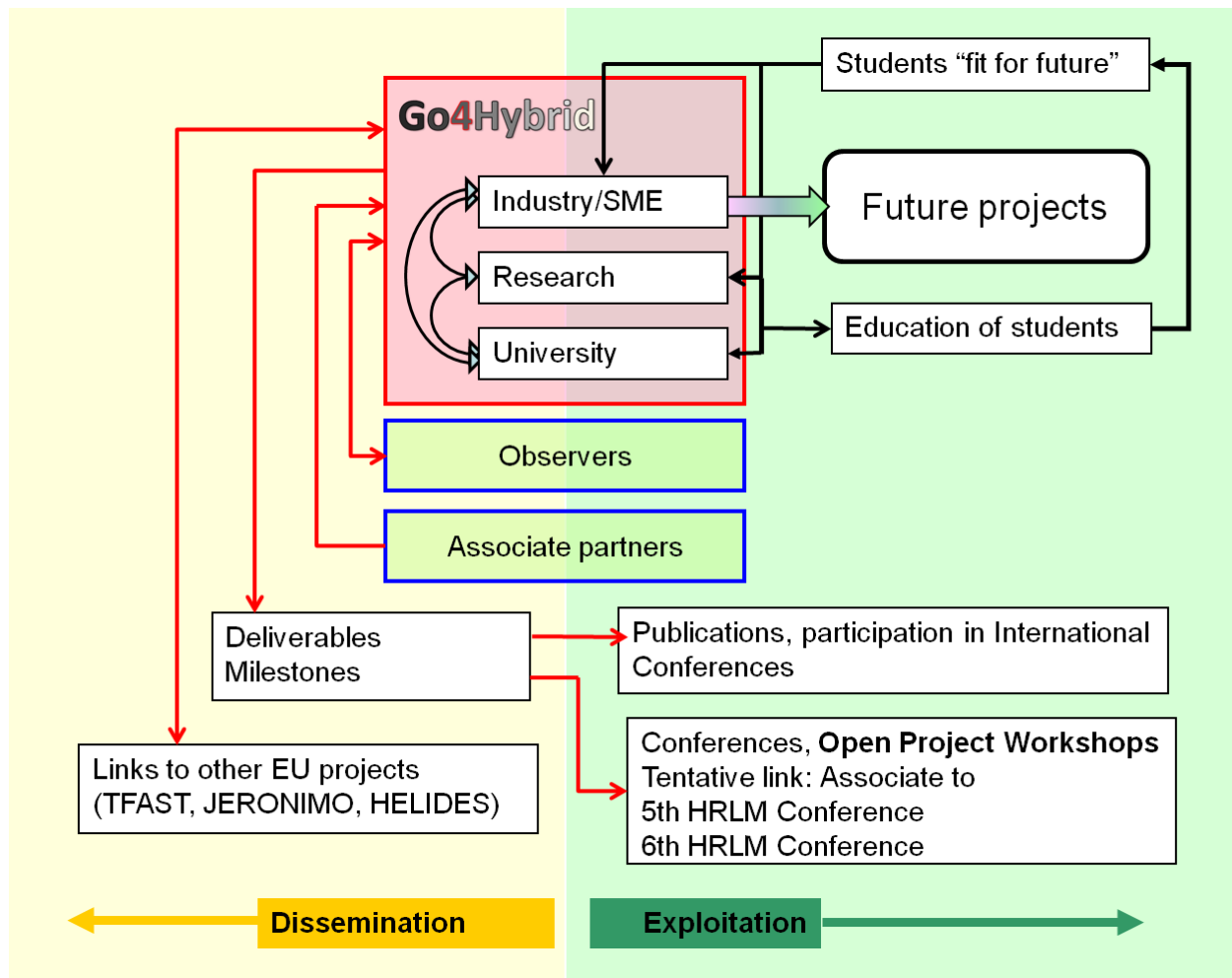
Figure 1   Sketch of dissemination and exploitation activities

Fig. 1 describes dissemination and exploitation issues in a graphical way and shall be explained in the following in more detail:

1. Dissemination and exploitation is represented by the yellow left hand part of the figure, while exploitation activities are related to the green right hand part of the figure.

2. Intentionally, the observer activities, represented by the blue bounded box, are split into dissemination and exploitation activities, in the exploitation case, direct and immediate exploitation is enabled. The same – but as said, somewhat limited – holds for the associate partners.

3. All partners in the Go4Hybrid project will exchange knowledge and expertise in an interactive way, as indicated by the red Go4Hybrid box.

4. "Links to other projects" are seen to be activities related to dissemination.

5. Red arrows indicate activities dedicated to Go4Hybrid as a whole; no specific inter-partner activities are meant here.

6. The black arrows are seen to be more partner-wise or to be at least organisational (industry-research- university) activities that are clear exploitation related.

7. Research labs and universities are providing additional means for educating students (pre- or post-diploma/PhD). Because of its future consequences, education of students is seen as an exploitation activity.

8. The main part of exploitation is aiming at future industrial use of the new and by the end of Go4Hybrid well validated hybrid RANS-LES methods – and the mitigation of grey area(s) – to ensure advanced, more accurate and reliable tools for future designs.

4   Further activities

There are two specific activities concerning exploitation/dissemination of knowledge:

4.1   5th HRLM Symposium

First of all, Go4Hybrid was the co-coordinator of the 5th conference/symposium on Hybrid RANS-LES Methods (**HRLM-5,** *www.hrlm-symposium.org*), that took place in College Station (near Houston), Texas, USA, from 19 to 21 March 2014. Coordinators are S. Peng, FOI, D. Schwamborn, DLR, and W. Haase, WHAC/CFDB. The fourth coordinator and at the same time the local organiser was Prof. Sharath Girimaji from A&M university.

All in all, 52 participants from 7 countries (Austria, China, France, Germany, Sweden, UK, USA) have registered with 44 presentations including 4 invited speakers (Basara (AVL), Hanjalic (Deft University and Novosibirsk State University), Spalart (Boeing), and Yakhot (Boston University)).

It should be mentioned that this conference was taking place rather early compared to the outcome of the Go4Hybrid project, however, however the project was presented by the technical coordinator of the project and accompanied by a few (early) papers with respect to work about hybrid RANS-LES modelling:

C. Mockett[1], W. Haase[2] and F. Thiele[1] ([1]CFD Software E+F GmbH, Germany; [2]WHAC, Germany)

Go4Hybrid: A European initiative for improved hybrid RANS-LES modelling

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N. Ashton and A. Revell (U. of Manchester, UK)

Grey-area mitigation for the Ahmed car body using embedded DDES

C. Mockett[1], M. Fuchs[1], A. Garbaruk[2], M. Shur[2], P. Spalart[3], M. Strelets[2], F. Thiele[1] and A. Travin[3] ([1]CFD Software E+F GmbH, Germany; [2]NTS, Russia; [3]Boeing Commercial Airplanes, USA)

Two non-zonal approaches to accelerate RANS to LES transition of free shear layer in DES

N. Renard and S. Deck (ONERA, France)

On the interface positioning in a zonal detached eddy simulation (ZDES) of a spatially developing flat plate turbulent boundary layer

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The conference, despite the big work effort (as usual higher than expected (!)), was and still is seen to be of utmost importance for the Go4Hybrid project as the conference offered a unique platform for technical discussions and an exchange of knowledge and expertise at the same time.

The consortium considers the co-coordination of the conference being equivalent to a mid-term workshop, which was offered in the original DoW.

4.2 6th HRLM Symposium

Secondly, at the end of the Go4Hybrid project, a final *open workshop* was envisaged as part of the DoW - to offer again a much broader platform for technical discussions. This workshop has to take place in September 2015, hence in conjunction with to the final meeting. It should allow for participation of external people interested in the field of hybrid RANS-LES methods and related modelling aspects.

However, there is one major drawback as far as the crowded meeting/conference schedules are concerned. The consortium fears that due to the tight meeting structure too few colleagues can be attracted to participate in such an open workshop.

Hence, another procedure is suggested, namely to skip the final workshop and participating (again) as a co-coordinator of the 6th HRLM conference – likely to take place in Strasbourg in Spring 2016 with Prof. Yannick Hoarau as the local organiser. This would offer a splendid platform to presenting the Go4Hybrid outcome, if necessary in a special session dedicated to the Go4Hybrid project.

5 The Go4Hybrid Web site

UniMAN has both setting up and is hosting the project web site. With the seven partners involved, a close co-operation will take place by use of the project Web site. Split into a private and a public part, the latter to be used for information about progress and intermediate results – of course, without violating the consortium rules. Internal dissemination of information, including reporting and Quarterly Progress Reports will be solely handled by the private part of the Web site. A document library has been set up and is available to all partners.

6 A link to ERCOFTAC

As concerns further dissemination and, moreover, exploitation, UniMAN is hosting the ERCOFTAC database of test cases. It is foreseen by the Go4Hybrid consortium that a selection of most interesting test cases will be reviewed by the consortium at the end of the project and then added to the database which is freely accessible and frequently used by the CFD community, see www.ercoftac.org

7 A link to GARTEUR

Not yet decided, but discussed already, another link will/can be established with the GARTEUR Action Group AG54. The question arose whether the TC F1 test case set-up should be released to GARTEUR. The reason would be straightforward as the GARTEUR action group is almost identical with the Go4Hybrid consortium. Nevertheless, it was decided to wait for an official letter from GARTEUR, because such action is seen to be a clear exploitation issue. At time of writing such letter has not been sent.

8 A link to other running EU Projects

It has been noted in the DoW that links to other EU projects should be established. The current status reads:

TFAST: This project is near to the final meeting, which means that no further help concerning grey area problems is needed. CFD work is quite advanced. However, there is at the time of writing this report a possibility that TFAST will receive a project prolongation (by likely one year). If the latter is going to happen, a contact will be established in order to check about whether a Go4Hybrid presentation will be given at the next meeting. A contact can be established via one of the Go4Hybrid observers, NUMECA, being a partner to TFAST, and/or via the administrative coordinator of Go4Hybrid, WHAC, being member of the TFAST advisory board.

HELIDES work will proceed in Go4Hybrid. On the other hand, Go4Hybrid is making use of HELIDES expertise. In particular the HELIDES mesh is available for Go4Hybrid.

JERONIMO: Models going to be developed in Go4Hybrid will be applied to jet-wing interaction noise. Moreover, in the German LuFo-IV project, AEROSTRUCT, models will be implemented which will be derived in Go4Hybrid. One of the Go4Hybrid project observers, Rolls-Royce, is guiding this issue.

9 Publication of final results

A first discussion has been taken place at the 6-month meeting on final publication of results. It was not yet decided on a "final" procedure, however, the coordinator provided reasons for "keeping the final results together". This means in turn that the consortium partners will try to write reports on test cases and methods in a way that can finally be integrated into a book – likely to be published by Springer in the NNFM series. Of course this provides the need to set up a structure for the book.

The main reason for such a book publication is exploit all results in a way which ensures the corporate identity of the project and to present it as a European initiative on collaborative effort on hybrid RANS-LES methods and approaches.

However, as said, at the time of writing a definite decision has not been taken.