Opticon – FP7-2
WP1 – Adaptive Optics

Coordinator: Jean-Luc Beuzit

Main objectives

The primary goal of Work Package 1 is to develop the technologies and the knowledge required to improve the performance and operational efficiency of existing AO facilities in Europe, as well as to develop the state of the art instrumentation required for the next generation of European astronomical facilities, i.e. the 40m European Extremely Large Telescope (E-ELT).

Proposed activities

- WP1.1: coordination (IPAG, UDUR, ONERA)
  - Coordinator: J.-L. Beuzit
  - Deputies: R. Myers and T. Fusco
  - Scientific team including ESO to keep close link with VLT/E-ELT activities and to ensure continuity with FP7-1
  - Kick-off meeting in January 2013 (IPAG)
  - Internal progress reports on 6-month basis
  - Annual meetings
  - Internal deliverables
  - Web site, mailing lists, etc.

Proposed activities

- WP1.2: future deformable mirrors
  - WP1.2.1: specifications and follow-up (IPAG, ONERA, LESIA)
  - WP1.2.2: large open-loop electromagnetic deformable mirror development (ALPAO)
    - embedded built-in position sensors
    - laboratory prototype, could be used on Canary
  - WP1.2.3: mini piezoelectric deformable mirror (IPAG)
    - connection of 40k actuators to high voltage amplifiers (400 V)

Proposed activities

- WP1.2: future deformable mirrors
  - WP1.2.4: Prototyping of cryogenic active mirrors (MPIA/NOVA)
    - not really AO but linked to cold tip-tilt and/or steering mirrors for 3-5 micron instruments

Proposed activities

- WP1.3: Towards LGS and NGS wave front sensing (Durham, OABo, LESIA, LAM, ONERA)
  - WP1.3.1 LGS WFS analysis and simulations
    - comprehensive simulations and error analysis of WF errors for LGS on ELT (sensor design, calibration issues and multi-LGS case with tomographic reconstruction)
  - WP1.3.2 LGS WFS laboratory demonstration
    - experimental validation of previous activity
    - upgrade of experimental facility at INAF-Bo to simulate realistic elongated LGS

Proposed activities

- WP1.3: Towards LGS and NGS wave front sensing
  - WP1.3.3 LGS WFS on-sky experiment
    - upgrade of Canary to provide unique capabilities for testing elongation effects in actual conditions
      - use of of-axis sodium laser (externally funded)
      - emulating sodium layer effects using modulation of range gate depth of existing Rayleigh LGS
  - WP1.3.4 Efficient NGS wave front sensing in multi-LGS mode
    - validate new concept of low order focal plane WFS using full telescope aperture (LIFT standing for LInearized Focal Plane Technique)

Proposed activities

- WP1.3: Towards LGS and NGS wave front sensing
  - WP1.3.5 On-sky E-ELT sky coverage optimization using Near IR-NGS sharpening
    - use of Canary combined with Rapid based NIR WFS
    - dedicated correction (DM controlled in open loop) in the NIR NGS wavefront sensing channels is a key concept for providing the sky coverage required for tomographic AO concepts
    - combined with LIFT should to ensure unprecedented sky coverage for future Laser assisted wide field AO

Proposed activities

- WP1.4: On-sky optimization and exploitation of AO data (ONERA, NOVA, LESIA, CRAL, IPAG, Durham, Porto)
  - WP1.4.1 Optimal tomography control law
    - investigate critical issues of control law design, optimisation and exploitation for wide field AO systems
    - robustness to AO and telescope parameter changes (pupil shift, rotation…)
    - on-line optimisation with turbulence statistics evolution

Proposed activities

- WP1.4: On-sky optimization and exploitation of AO data
  - WP1.4.2 Calibration of interaction matrix
    - on-line estimation of key parameters of interaction matrix using closed loop data
    - approach will be tested in the laboratory with the ASSIST test facility and on-sky at VLT
    - compare approaches in terms of residual WF errors and image quality

Proposed activities

- WP1.4: On-sky optimization and exploitation of AO data
  - WP1.4.3 On-line estimation of tomographic reconstructor
    - best tomographic reconstructor (control matrix) of either an open loop (MOAO) or closed loop (GLAO and LTAO) system
    - use observed environmental conditions (DIMM / MASS data, wind speed, etc) and specific calibration procedures and data delivered by the AO system
    - validation with the CANARY demonstrator

Proposed activities

- WP1.4: On-sky optimization and exploitation of AO data
  - WP1.4.4 Cn2 turbulence profile estimation
    - comprehensive analysis of impact of Cn^2 knowledge on the wide-field AO performance
    - implement and validate new approaches to retrieve the Cn^2 profile using on-line WFS data
    - full end-to-end simulation
    - comparison with existing Cn^2 profilers (SLODAR) at WHT using the Canary experiment

Proposed activities

- WP1.4: On-sky optimization and exploitation of AO data
  - WP1.4.5 PSF reconstruction for wide field AO
    - directly applied to MUSE instrument
    - use of data from both LGS and NGS to derive PSF at any location of FoV and every wavelength
  - WP1.4.6 Lesson learned from SPHERE
    - feedback on critical design choices
    - improvement for SPHERE itself and EPICS perspective

Proposed activities

- WP1.5: Outreach (Porto, IPAG, ONERA, Durham)
  - Demonstration bench not funded, but benches available in several places
  - Main goal is to develop the educational worksheets and validate in schools, etc.

Deliverables

List of deliverables

Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D1.1	Report on Technical Specifications for the DM developments	2	1.00	R	PU	15
D1.2	Efficient calibration for complex AO systems: theory, simulation and experimental results test repor	8	1.00	O	PP	33
D1.3	Educational worksheets	15	1.00	O	PU	33
D1.4	Adaptive Optics Design and Test Report	2	1.00	O	PP	48
D1.5	Report on Natural Guide Star Experiments	18	1.00	R	PU	33
		Total	5.00			

Milestones

- No more milestone in last version of proposal !
- Internal milestones will still exist (see coordination)

Participants and efforts

Work package number	WP1	Start date or starting event			01-01-2013			
Work package title	Towards Adaptive Optics for the European Extremely Large Telescope							
Activity type	RTD							
Participant number	2	3	4	8	15	17	21	25
Participant short name	CNRS	INAF	Max Planck	ONERA	UPORTO	UDUR	UL-NOVA	ALPAO
Person-months per participant	77	36	6	43	24	31	7	33

Total level of efforts:

Manpower = 257 person months

Total cost = 2.680 M€ / 2.822 M€

Requested cost = 2.010 M€ / 1.939 M€

Thanks !