A significant step toward source automation with Vibrator Auto-Guidance

Alexandre Maugère, Gilles Ollivrin, Philippe Sicot and Nicolas Tellier, Sercel ; Hussain Al Zayer, Argas*

Introduction: automation in seismic operations: an enabler for higher trace densities

Recent land acquisition projects are characterized by a trend towards higher trace densities, now widely recognized as the key parameter for efficient reservoir analysis. In practice, higher trace densities (i.e., higher fold and smaller bin size) are achieved on the receiver side by larger channel-count spreads, and on the source side by single vibrators operating with advanced productivity techniques, such as blended shooting. Meanwhile, the source productivity is a cost-enabler for these advanced projects. Automation is considered by many as a solution to meet the productivity objectives and scale down operational expenses. Though receiver automated deployment and pick up remains in its early stages in the face of a wide variety of terrain and environmental challenges, significant advances are being made on the source automation side.

A first step in source automation for higher productivities and improved positioning accuracy

The operation of seismic vibrators can be broken down in four stages. Once a vibration point n is completed (VP_n), a cycle consists of 1) Raise baseplate, 2) Travel to the VPn+1 location, 3) Lower baseplate and 4) Vibrate. With modern Vibroseis equipment, stages 4) and 1) usually have some automation: the vibration is started as soon as the baseplate is down and within positioning tolerances, and the baseplate is raised as soon as the sweep is complete.

The Vibrator Auto-Guidance solution addresses the two remaining steps. When approaching a VP position, control is taken over vibrator speed and the deceleration is optimized to reduce the travel time between VPs. Baseplate lowering is also managed automatically and is activated before the VP location is reached: it can therefore not only be mainly performed in masked time, but also allows the “full-up” option to be used rather than the “half-up” option, what reduces the probability of actuator damage due to obstacles under way. When automated, these two steps offer constant and optimized productivity improvements, as the uncertainties associated with drivers’ variable performances (for example owing to their experience) are removed.

The vibrator positioning accuracy is also improved and lies within a 1-m radius, paving the way for a potential reduction of the typical 3-m radius acceptance criterion. The solution has been designed as an add-on, installable in less than an hour on a large range of vibrators without prior expertise for setup and operations.

Automation and HSE

As for autonomous cars, HSE is a major concern when automating operations. For this reason, manual control can be taken back instantly by drivers, simply by releasing the gas pedal. When approaching a VP, the driver’s attention can be focused on the environment rather than on decelerating and positioning the vibrator. As managing vibrator acceleration is associated with higher HSE exposure and limited travel time gain than with deceleration, no automation of the acceleration phase has been implemented in the present solution, but would be achievable should the industry confirms interest, provided robust and redundant safety devices are employed.

Field experience

To validate the performance of the solution, field tests were performed early 2019 on crew in the Middle East. Figure 1 displays the results achieved for a 90 VP line with a 12.5 m VP interval, shot with and without Auto-Guidance by a driver with limited experience. When using Auto-Guidance, the vibrator travel time was reduced by 23 %. The accuracy of positioning was also improved, lying within a 1-m radius, and showing very good repeatability.

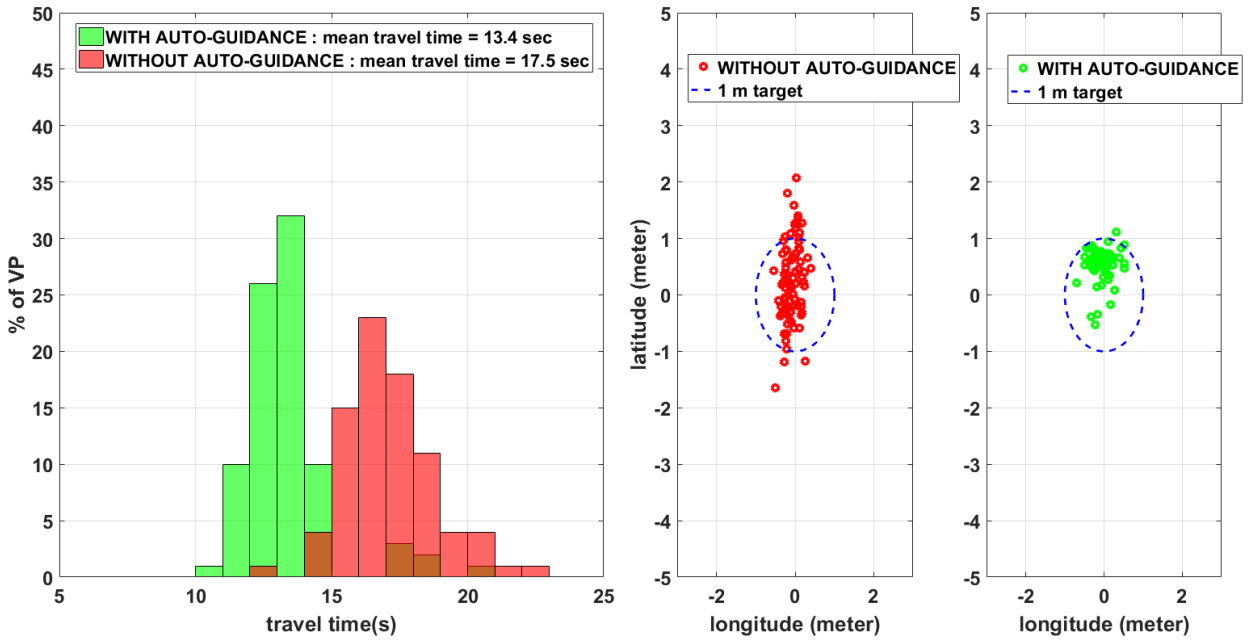

Figure 1: Manual driving vs. Vibrator Auto-Guidance: comparisons of (left) travel time for a 12.5 m distance between VPs, and (right) positioning accuracy.

The overall benefit of the solution on crew productivity depends on numerous parameters, such as ground conditions, drivers' experience and acquisition parameters. However, a good estimate is around 10% productivity improvement for Middle East mega-crews. The deployment of the solution on a commercial project is planned in the upcoming months: productivity results and field observations will be presented and discussed.

Conclusion: towards full automation of vibrators?

Seismic operation full automation is seen by many as the future of our industry, for the improved productivity and reduced operational expenses it promises. Vibrator Auto-Guidance is a first step in this direction on the source side, and proves particularly adapted to current Middle East acquisitions, with single vibrators and blended shooting. Although further source automation is technically feasible with current technologies, it requires additional, costly features for HSE acceptance. Manufacturers will be provided with a strong indication of the direction of further developments in source automation by the feedback from industry and the degree of uptake of the proposed solution.