

EFFICIENCY IMPROVEMENTS IN HONEY EXTRACTION ROOMS: SHIFT MANAGEMENT AUTOMATED THROUGH GENETIC ALGORITHMS



María M. Vives^{a,d}, Anahi Briozzo^b, Nélida B. Brignole^{a,c}

^a Laboratorio de Investigación y Desarrollo en Computación Científica (LIDCCC) - Departamento de Ciencias e Ingeniería de Computación (DCC) - Universidad Nacional del Sur (UNS), Bahía Blanca, Argentina
^b Departamento de Ciencias de Administración (DCA) - BISS (CONICET), Bahía Blanca, Argentina
^c Planta Piloto de Ingeniería Química (UNSA-CONICET), Bahía Blanca, Argentina
^d Comisión de Investigación Científica (CIC), Buenos Aires, Argentina



ABSTRACT

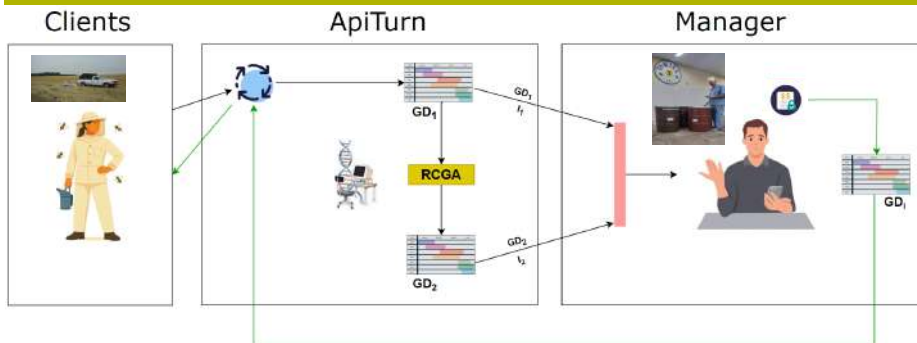
ApiTurn: A general shift management system is presented.

- **ApiTurn** is an accessible online planning tool
- It aims at maximizing productivity.
- It is an **INTELLIGENT DECISION-SUPPORT SYSTEM**: The manager can always make the final scheduling decisions.
- It supports the decisions that concern creating and managing shifts:
 - Minimization of the amount of equipment washings
 - Optimization of the use of the extraction room in a working week.
- It was implemented for mobile phones.
- Flexible, user-friendly application both for clients and managers of honey extraction rooms
- **ARTIFICIAL INTELLIGENCE (AI) APPROACH**: Ad hoc design of a specialized Genetic Algorithm (GA)
- **RETUNING OF GANTT'S DIAGRAM**: More profitable scheduling is proposed thanks to RCGA

OPTIMIZATION METHODOLOGY

- The optimizer **RCGA** is methodologically inspired from population genetics.
- Every possible solution is represented by a "digital individual".
- After the generation of an initial set of feasible solutions, individuals are randomly recombined or mutated.
- The resulting individuals undergo a process of natural selection, which favors the survival of the fittest (the best solutions).
- The evaluation is done by a fitness value, which scores some characterizing aspects, thus yielding the scheduling benefits.
- The model was built by addressing the hierarchical structuring of the requests:
 - It allows an easy effective identification of a client's relevance through a file that helps to prioritize urgencies and key clients.

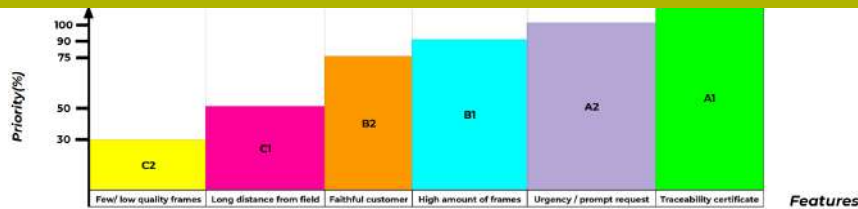
SHIFT MANAGEMENT SYSTEM



GD_1 = Gantt's diagram in order of request
 GD_2 = proposed Gantt's diagram
 I_i = fitness (GD_i): income



CLIENT CLASSIFICATION FOR THE OPTIMIZER



APP IMPACT METRICS

IMPACT METRIC	UNIT OF MEASUREMENT	VALUES IN TRADITIONAL PRACTICE Without ApiTurn	IDEAL VALUES When supported by ApiTurn	IMPACT METRIC	UNIT OF MEASUREMENT	VALUES IN TRADITIONAL PRACTICE Without ApiTurn	IDEAL VALUES When supported by ApiTurn
Efficiency in production	Real production / Standard production x 100 (%)	72	100	Product quality	Tonality (% change)	20	0
Quantity of extracted honey	kg/day	6400	7000	Disturbances of the manager by creating alterations in customers who request turns	Number of interruptions/week	25	0
Overtimes	Weekly frequency	3	0				
Site time	Hours/week	4	1				
Production room utilization rate	Production room / total room x 100 (%)	84	100				

CONCLUSIONS

- **ApiTurn** strategy is innovative as a modelling/ diagnostic tool.
- **ApiTurn** supports beekeeping decisions on changing problems that are not easily diagnosed in advance.
- An adequate ad-hoc implementation of this approach may enrich the shift platforms of any honey-extraction room.

CONTACTS

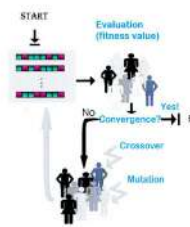


martinmartz@yahoo.com.ar



dybrigno@criba.edu.ar

RCGA: REAL-CODED GENETIC ALGORITHM



FUTURE WORK

- **ApiTurn's** modules can straightforwardly be adapted to local issues, thus contemplating significant cost savings in shift management.
- Further testing is vital to complete thoroughly the computational design.
 - General verification should be conducted to check whether this approach is always both rigorous, efficient and effective.
 - **REALISTIC TESTING**: to be conducted during next summer season for Tomiel's scheduling.
- It is advisable to explore efficient implementation alternatives for the optimizer to tackle with computing time-demanding problems, so that the AI solver helps to find improved solutions even faster.

Maria de los Milagros Vives¹, Anahí Briozzo², Nelida Beatriz Brignole³

¹Laboratorio de Investigación y Desarrollo en Computación Científica (LIDECC)-Departamento de Ciencias e Ingeniería de la Computación (DCIC), Universidad Nacional del Sur (UNS), 8000 Bahía Blanca, Argentina

²Departamento de Ciencias de la Administración UNS- IIESS (CONICET), 8000 Bahía Blanca, Argentina

³LIDECC-DCIC and Planta Piloto de Ingeniería Química (UNS-CONICET), 8000 Bahía Blanca, Argentina

In the era of Industry 4.0, digitalization has become one of the main innovation drivers. In particular, for efficient beekeeping practice AI technologies may improve the organization of honey extraction rooms, especially when the seasonal demand increases abruptly. Therefore, we have designed a specialized Genetic Algorithm (GA) called ApiTurn. It is a shift management tool focused as a flexible, user-friendly application both for clients and managers of honey extraction rooms. It aims at maximizing productivity by means of an accessible online planning tool that supports the decisions that concern creating and managing shifts. The optimizer GA is methodologically inspired from population genetics. Every possible solution is represented by a "digital individual" and after the generation of an initial set of feasible solutions, individuals are randomly recombined or mutated. The resulting individuals undergo a process of natural selection, which favors the survival of the fittest (the best solutions). The evaluation is done by a fitness value, which scores some characterizing aspects, thus yielding the scheduling cost. The model was built by addressing the hierarchical structuring of the requests, which allows an easy effective identification of a client's relevance through a file that helps to prioritize urgencies and key clients.

ApiTurn provides a shift management system that allows to minimize the number of equipment washings and to optimize the use of the extraction room in a working day. It is an innovative computational optimization tool for mobile phones and adapted to the reality of the beekeeping sector. It was exclusively addressed to a specific set of users and their cell phones. To make the structure elastic, it was conceived with two blocks: one where the client books his shift in a proposed schedule; the other one is for the manager, who accepts or modifies the request. Shifts were enhanced by a tree of additional data, like breaks for lunch, the distribution among several extraction lines and plant stops.

ApiTurn will support beekeeping decisions on changing problems that are not easily diagnosed in advance. Its modules can straightforwardly be adapted to local issues, thus contemplating significant cost savings in shift management.